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# Improvement of Patient's Satisfaction and Oral Health-Related Quality of Life by the Implant and Prosthodontic Treatment

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## 1. Introduction

Improvement of oral health and quality of life is the main goal of contemporary dentistry, since it has been considered as an important part of patient's well-being. Eliminating oral pain and the problems connected to chewing and speech, as well as the improvement of aesthetic contributes the improvement of oral health.

When assessing the outcomes of dental treatment, it is important to consider the clinicians' as well as the patients' point of view. Therefore, the four basic parameters have been identified, which describe these objective and subjective outcomes:

- biologic and physiologic parameters (health of oral structures, nutrition, chewing, and esthetics),
- longevity and survival rate (of teeth, restorations, implants),
- psychosocial parameters (treatment satisfaction, self-esteem, body image, quality of life, benefit, utility)
- and economic parameters (cost-effectiveness, direct and indirect cost) (Anderson, 1998; Guckes et al., 1996).

The first two categories have been investigated extensively so far by the clinicians, while in the last few decades the psychosocial outcomes have also gained lots of interest (Buck & Newton, 2001).

According to Assunção et al. (2007), patient satisfaction depends on factors such as chewing, stability, comfort (fit), esthetics, taste and speech. In addition to these clinical aspects, an understanding of the impact of denture on a patient's well-being is required to help patient and dentist to make the decision which treatment option would be the most appropriate in prosthodontic rehabilitation. To evaluate the effect of prosthetic therapy on patient satisfaction psychosocial outcomes factors (general satisfaction, social impact, self-esteem) also have to be used (Assunção et al., 2007). In other words, outcomes of treatment have to be assessed by subjective perceptions of the patient, as well as by objective tests. In some articles only subjective or objective assessments have been used, while in the other both

outcomes have been evaluated (Attard et al., 2006; Burns et al., 1994; Heydecke et al., 2004; Kleis et al., 2010; Zani et al., 2009).

Since the interest to evaluate psychosocial factors has been increased in the last two decades, many publications used only subjective outcomes. Their wide usage is based on low cost and simplicity since already one single questionnaire can measure changes in patients' perceptions regarding satisfaction and oral health related quality of life (OHRQoL) outcomes before and after treatment. Other type of questionnaire has been used in retrospective studies to remember the patients of their experience with previous dentures and rate the change after receiving new denture (Kimoto & Garrett, 2005). Since the retrospective studies rely on patient memory, the data can also be unreliable and inaccurate (Allen et al., 2001b).

Oral health-related quality of life (OHRQoL) is an important patient-centered endpoint to be considered when assessing the impact of oral diseases and evaluating professional interventions (Heydecke et al., 2003b). In other words, it can be defined as a person's assessment of how functional, psychological and social factors and pain/discomfort affect his or her well-being—in the context of oral health (Inglehart & Bagramian, 2002). This opens new opportunities in clinical work, research and education. According to Locker different aspects of OHRQoL have different levels of importance to an individual, depending on their age and general health status (Locker & Miller, 1994).

OHRQoL is a multidimensional construct that has been assessed by various questionnaires that collect data not only about oral health status, but also about other oral health dimensions that affect quality of life. They should reflect the influence of the oral status on personal and social well-being (Elinson, 1974). Some questionnaires measure different dimensions, while others are focused on a particular dimension of oral health (Inglehart & Bagramian, 2002). The most of the questionnaires are trying to describe the negative effect of oral conditions like loss of teeth and denture therapy on OHRQoL. One problem of nonspecific, broad questions is the high number of false-positive responses; therefore, they should always be complemented by more specific items. The questions are mostly related to general satisfaction, as well as to more specific items like chewing, speech, comfort and esthetics. According to Awad these items are the most relevant ones (Awad et al., 1998). Concerning the prosthodontic, patient's physical and psychosocial negative experiences with previous dentures are of high importance, since they may influence on decision and satisfaction with new implant and prosthodontic rehabilitation (Kapur et al., 1999).

The high-general satisfaction score in many studies may be a result of general questions that give more positive response than narrowly focused questions (Strassburger et al. 2006). The development of validated, multi-item questionnaires for the measurement of OHRQoL has made significant progress, since they have good measuring characteristics to assess the type of therapy and its success. This led to the development of longer, more complex instruments. Some questionnaires, like the Oral Health Impact Profile (OHIP) (Slade & Spencer, 1994) have been translated into different languages and have been accepted worldwide.

Most of the questionnaires haven't been standardized what makes the results less valid, less meaningful and less comparable (Strassburger et al., 2006), while the standardization and validation of the questionnaires makes them reliable and allows comparison of results

(Strassburger et al., 2004). It would be best to compare the data between the studies, but since the most of them used self-made questionnaires and different graduation scales, this would be inappropriate (Melas et al., 2001).

To avoid the bias in the study clinician shouldn't be involved in the study, since the patients would assign better scores not to offend their dentist (Allen et al., 2001b). Problem, which is often encountered in studies, is also the lack of a control group not allowing the comparison of results with a non-treated general population and assessment of real treatment effects (Boerrigter et al., 1995a). Another problem is a short follow-up period, which is very important in the group of patients with slow adaptation capabilities (Roumanas et al., 2003). Finally, we could conclude that the selection of the appropriate psychometric instrument for evaluating OHRQoL has a powerful influence on the final result, as instruments specifically designed for problems related to the oral cavity. In many publications self-made questionnaires have been used, but recently more studies asked to complete an Oral Health Impact Profile (OHIP), that is apparently more sensitive than generic ones that assess the health-related quality of life (Allen et al. 1999; Allen & McMillan, 2003; Heydecke et al., 2003b).

The OHIP is a self-administered instrument specifically designed to measure the impact of oral health on psychosocial well-being and quality of life (Slade & Spencer, 1994). This questionnaire includes 49 items that cover seven domains: functional limitation, physical pain, psychological discomfort, physical disability, psychological disability, social disability and handicap. The five categories of choice per item are: never, rarely, occasionally, often, and very often; and are coded from 0 to 4, with the higher scores indicating more serious problems.

OHIP and its modifications (several shortened versions) show reasonable degree of cross-cultural consistency, discriminance and hence good construct validity properties. As it is oral specific, it will be of greater use in measuring outcomes of oral disorders than generic measures such as SF-36. It was concluded that sensitivity to change of the OHIP was good. This property was not improved by using statement weights (Allen et al., 2001b).

The important part of the standardization is the usage of the same scale, such as the Lickert scale (from 1 to 5) or VAS (visual analog scale). The VAS consists of a line 10 cm in length representing a spectrum of feeling between two extremes identified by end-phrases. For example, in response to the question, "do you feel discomfort with your mandibular prosthesis," the left side end-phrase would represent the response "always," whereas the right side would represent "never." In another words the line represents the graduation from zero point or percentage to the 100% value and the most favorable response for the question. A vertical mark on the line represents their feelings at that time, or the degree of comfort in the example (Cibirka et al., 1997). This finding will be relevant when considering the use of health-related quality of life measures to target resources and measure the outcome of clinical intervention (Allen et al., 1999).

The other widely used standardizes generic health status questionnaire is SF36, a generic health status measure developed in the United States (Ware & Sherbourne, 1992). The SF36 consists of 35 statements divided into eight subscales (physical functioning, social functioning, role limitation-physical, role limitation-emotional, mental health, vitality, pain and general health perception). There is also a self-assessed global transition statement asking respondents to compare their general health status with one year previously.

In general population, the number of teeth has the strongest impact on the OHRQoL (Allen & McMillan, 1999). In elderly, tooth loss has an adverse effect on different aspects of quality of life, particularly in institutionalized individuals where the loss of teeth may constitute a severe handicap (Sheiham et al., 2001). As pointed out by Blomberg (1985), the teeth do not only serve as a part of the masticatory system, but as the part of the oral region have also an important part in speech and psycho-sexual functioning. Therefore, the loss of teeth is equivalent to the loss of an organ with several implications to the individual (Albrektsson et al., 1987).

Although the prevalence of edentulism is falling (Steele et al., 2000), the percentage of older people is still increasing in population (Thompson & Kreisel, 1998). Since the missing occlusal units are related to OHRQoL impairment (Baba et al., 2008) it is necessary to provide a treatment to reconstruct their number and provide satisfactory oral function. To replace the missing tooth different treatment possibilities have been proposed. Until recently two main options for restoring the function and esthetics of non-restored or inadequately restored spaces were tooth-supported fixed partial dentures (FD) and conventional removable dentures (CD). Loss of more teeth and their inappropriate position requested denture as only option. Due to lack of denture retention and stability in many denture-wearing patients diet is poor and speech is unclear (Kapur, 1987). Therefore, the success of classical denture treatment very often depends on a patient's adaptive capacity to overcome these limitations (Carlsson, 1998).

In recent years the implementation of implant therapy has gained more importance and significance as a therapy option, as it provides significant improvement in stability, retention and OHRQoL of edentulous patients (Assunção et al., 2009; Strassburger, 2006). Many studies evaluated the outcomes of two-implant supported mandibular overdentures (IOD) opposed by conventional maxillary prostheses (Awad et al., 2000; Cibirka et al., 1997; de Bruyn et al., 1997; De Grandmont et al., 1994; Kent & Johns, 1991; Kiyak et al., 1990; Pera et al., 1998; Tang et al., 1997).

The impact of different non-implant and implant dental treatments on patient's OHRQoL has been assessed. Detailed questions with regard to specific aspects of the dentures give insight into aspects that have been improved by the treatment. Such factors include satisfaction with comfort, chewing, stability and esthetic. To date, clinical studies have mainly been focused on OHRQoL outcomes of partial and complete dentures (CD) (Celebic & Zlataric 2003; Forgie et al., 2005). In the last two decades some studies also evaluated implant therapy by changes of the patient's OHRQoL (Allen et al., 2001b; Allen & McMillan 2003; Strassburger et al., 2006; Zani et al., 2009), and their number increases constantly (Strassburger et al., 2004). According to some studies, quality of life has been significantly improved after the treatment with implant-supported overdentures (IOD) in comparison to the previous experience of wearing CD (Awad et al., 2003b). With respect to chewing (Geertman et al., 1996a), bite force (Fontijn-Tekamp et al., 1998), comfort, function, speech, esthetic, self-image and dental health (Cibirka et al., 1997), IODs provided greater improvement of oral health. Concerning the rehabilitation in elderly, improvement of functional aspects and oral health has been confirmed (Allen et al., 2001b; Heydecke et al., 2003b), as well as after the rehabilitation with implant-supported fixed dentures (IFD) (Berretin-Felix et al., 2008). Despite some articles and general opinion that patients who have IOD are less satisfied and have lower OHRQoL than the patients with IFDs (Heydecke et al.,



2003a), some authors found out that both patient groups have been equally satisfied (Zani et al., 2009).

All these studies confirmed that patient based outcome measures are necessary in clinical decision making, and that specific instruments are needed to clinicians and researchers to assess these outcomes. A shift from clinical longevity toward health status assessments has been made in order to improve patients benefit. For clinician this information means enhancement to design therapeutic interventions. The argument for the use of these measures must be made on practical not theoretical grounds. Therefore, it is important to prove to clinicians that measuring health status is useful in improving patient care and that these measures are important tools in the service of their patients (Hayes, 1998).

## **2. Aim of the study**

The aim of this chapter was to undertake systematical search (electronic and manual) of the current dental literature to identify and classify articles (according to their level of evidence) on satisfaction and oral-health related quality of life (OHRQoL) outcomes after implant-prosthodontic rehabilitation. The collected literature was systematically reviewed and outcome variables analyzed trying to summarize the characteristics of the studies published so far. The aim was also to induct the future direction according to missing or deficient data. It was hypothesized that the number of studies based on high-level evidence, using patient-based outcomes is small in some areas, and that some treatment possibilities haven't been investigated.

## **3. Materials and methods**

### **3.1 Search strategy and inclusion/exclusion criteria**

We conducted a systematic dental literature search until July 2011 in the Medline (PubMed) electronic databases. For this purpose a detailed search strategy for Medline was developed (Fig. 1.). Groupings of words were created which were internally combined with the Boolean term 'OR'. The first group consisted of the terms connected to the treatment: implant supported, dental implant, dental implantation, denture, overdenture, dental prosthesis, dental prostheses, prosthodontic, fixed prosthodontic, fixed prosthesis, fixed prostheses, and fixed partial denture. The second group consisted of the terms related to the outcomes of interest: satisfaction, patient satisfaction, patient outcome, quality of life, dental health surveys, health status measures, oral health, oral health-related quality of life, oral health impact profile and visual analog scale. These two groups of terms were then combined using the Boolean term 'AND'.

The titles and abstracts were screened by two of the authors (NP and KRS) to identify articles with the focus on the satisfaction and OHRQoL outcomes after implant-prosthodontic rehabilitation.

Full review of publications was done according to inclusion/exclusion criteria (Fig. 2.) and level of evidence (Fig. 3.).

The articles that did not evaluate the psychosocial outcomes were excluded, no matter if they included clinical outcomes. Further exclusion criteria were insufficient description of the sample characteristics or the therapeutic intervention, and missing or unclear hypotheses. Only the articles published in English were included since their international recognition.

Search #1	Search #2	Search #3:
implant supported (5922)	satisfaction (116664)	(#1) AND (#2)
dental implant (23213)	patient satisfaction	Limits Activated:
dental implantation (16242)	(69431)	English,
denture (42373)	patient outcome (613578)	Humans,
overdenture (2982)	quality of life (164691)	All Adult: 19+ years,
dental prosthesis (81884)	dental health surveys	Review,
dental prostheses (83109)	(18037)	Meta-Analysis,
prosthodontics (91866)	health status measures	Randomized Controlled Trial,
fixed prosthodontics (11626)	(31232)	Controlled Clinical Trial,
fixed prosthesis (11626)	oral health (31232)	Clinical Trial
fixed prostheses (16266)	oral health-related	
fixed partial denture (8526)	quality of life (1123)	
	oral health impact profile	
	(624)	
	visual analog scale	
	(64045)	
OR (106450 hits)	OR (905141 hits)	AND (1410 hits)

Fig. 1. Strategy for the electronic search (July 2011)

Inclusion criteria	Exclusion criteria
<ul style="list-style-type: none"><li>• Implant/prosthodontic focus</li><li>• Use of a patient-based outcome (measurement of OHRQoL or satisfaction)</li><li>• English language</li></ul>	<ul style="list-style-type: none"><li>• No clear research question or hypothesis</li><li>• Missing or insufficient reporting of data</li><li>• Patients under 18 years</li></ul>

Fig. 2. Inclusion and exclusion criteria

Ia	Evidence obtained from a meta-analysis of randomized controlled trials
Ib	Evidence obtained from at least one randomized controlled trial
IIa	Evidence obtained from at least one well-designed controlled study without randomization
IIb	Evidence obtained from at least one other type of well-designed quasiexperimental study
III	Evidence obtained from well-designed non experimental studies, such as comparative, correlational, or case studies
IV	Evidence obtained from expert committee reports or opinions and/or clinical experiences of respected authorities

Fig. 3. Classification of the levels of evidence of the articles by the US AHCPR

3.2 Assessment of publication quality

The levels of evidence of the articles were classified following the guidelines of the US Agency for Health Care Policy and Research (AHCPR) and are presented in Fig. 3. (Agency for Health Care Policy and Research, 1992).

The number of studies with high evidence level has increased in the last two decades improving the quality of the conducted trials. Therefore, a satisfactory number of articles of the high levels of evidence, (level I and II) have fulfilled our criteria and are included in this chapter.

The whole range of publications of lower levels of evidence has been identified, but they were omitted since they were retrospective and non-experimental and may compromise the findings (Assunção et al., 2009).

3.3 Data collection and statistical analysis

All identified publications were obtained from the University Library and electronically. From each article the following data were collected: year of publication, level of evidence, follow-up period, patients number and their average age, intervention characteristics, jaw treated, main outcomes (general satisfaction, oral and general health-related quality of life), number and type of implants. For data analysis the SPSS statistical software was used.

4. Results

Through the MEDLINE search a total of 1410 articles were identified and abstracts were reviewed according to inclusion criteria. According to the aim of the study 10 publications fulfilled criteria for edentulous maxilla treatment, 72 for edentulous mandible treatment and 9 for partial edentulous treatment; all together 87 articles were detected for implant treatment outcomes.

The number of studies with a high level of evidence dealing with patient's satisfaction and OHRQoL has increased steadily over the last 2 decades (Fig. 4.). However, one of the major short-comings of these studies has been usage of non-standardized questionnaires, which results can not be compared between the studies. Only 11 studies have been identified that used a standardized questionnaire, such as OHIP (Allen & McMillan, 2003; Allen et al., 2001b; Attard et al., 2006; Awad et al., 2000, 2003b; Berretin-Felix et al., 2008; Heydecke et al., 2003b, 2005a; Kleis et al., 2010; Zani et al., 2009;) and SF-36 (Allen & McMillan, 2003; Heydecke et al., 2003b).

Period of publication	Percentage of studies
1960-1990	4,45 %
1991-1995	14,29 %
1996-2000	25,27 %
2001-2005	30,77 %
2006-2011	25,27 %

Fig. 4. Schematic diagram of articles considering evaluation criteria

The average number of included patients in all studies that met inclusion criteria was 66.59, with the mean age of 58.85 of all patients. More than the half of the studies used short



follow-up period of only few months, with the longest period of 10 years (Naert et al., 2004). Therefore, the average follow-up period was 27.96 month. In most of the cases Branemark implants were inserted (14 articles), followed by Straumann implants (5 articles).

#### 4.1 Treatment option for the edentulous maxilla

For implant-supported dentures in the edentulous maxilla two main options have been proposed; the fixed screw-retained implant denture (IFD) and the removable implant overdenture (IOD). Both fixed and removable prostheses can be attached to the edentulous maxilla, but different results concerning the efficacy of the treatment have been proposed. Both designs have been tested in clinical studies, but since the denture design shouldn't be selected randomly or only on the clinical findings, patient's preferences have been investigated as well.

Only 10 investigations with evidence level I and II have been published about patients' assessment of the implant rehabilitation outcomes in the edentulous maxilla (Table 1). VAS and categorical scales have been used to assess the outcomes after the treatment.

Concerning the IOD treatment, 7 found a higher level of satisfaction than for CD (Aarts et al., 2008; de Bruyn et al., 1997; Heydecke et al., 2003a, 2004; Naert et al., 1998; Watson et al., 1997; Zitzmann & Marinello, 2000;). The advantage of the this treatment is significantly better mastication and speech demonstrated (de Bruyn et al., 1997; Heydecke et al., 2003a, 2004; Naert et al., 1998, Watson et al., 1997), as well as comfort, stability, and esthetics (de Bruyn et al., 1997; Naert et al., 1998; Watson et al., 1997; Zitzmann & Marinello, 2000). On the other hand, de Albuquerque et al. (2000) demonstrated different outcomes. According to his within-subject crossover trial outcome ratings of the IOD were not significantly higher than for new maxillary CD. Therefore, de Albuquerque suggests that maxillary IOD should not be considered as a general treatment of choice in patients with good bony support. The result of the study also showed absence of the difference between dentures with and without the palate coverage.

This result is supported by the general fact that the lower percent of the patients complain on their maxillary than on mandibular CD. In other words, the satisfaction with maxillary dentures was higher than for mandibular dentures, which again reflects common clinical findings. The reason is better anatomical condition that provides better stability and retention of maxillary CD, therefore better function and higher satisfaction.

Concerning the IFD treatment, all 4 publications agree that patient satisfaction is higher after the treatment (de Bruyn et al., 1997; Fischer & Stenberg, 2006; Heydecke et al., 2003b; Peñarrocha et al., 2007). High patient satisfaction was confirmed by the fact that 90 % of the patients would undergo the same treatment again (de Bruyn et al., 1997). There is a strong belief among clinicians and patients that IFD provide greater patient acceptance and satisfaction than IOD. But the clinical studies currently available indicate the advantage of IOD over the IFD treatment, and concluded higher degree of general satisfaction, better esthetic, better speech quality and easier cleaning with IOD than with IFD (Heydecke et al., 2003b, 2004). In the within-subject crossover trial by Heydecke et al. (2003b) the majority of the patients chose the IOD at the end of the trial.

A prospective clinical trial (fixed vs. removable) by Zitzmann & Marinello (2000) demonstrated that the both denture designs were associated with significant improvements in comfort (fit), stability and retention, function, esthetics and appearance, taste, speech, and

self-esteem. No difference was found between the patients assessment of these two treatment option. However, the results indicated that patients after receiving IOD experienced greater differences between pretreatment and post treatment scores for the parameters esthetics, taste, and speech.

It would be very interesting to analyze the cost-benefit of each treatment option, but the number of these studies is very low. One study demonstrated that the treatment cost per unit was significantly higher in IFD than in IOD group of patients (Zitzmann & Marinello, 2000). The overall positive results from the VAS questionnaire indicate that cost-utility and cost-benefit justify the expense in this 6-months period. The author suggested that the number of years that dentures last should be included, as well as the observation period should be prolonged to fully assess the cost of the treatment.

Clinical studies including the speech improvement showed advantage of IOD treatment. Heydecke et al. (2004) demonstrated in their within-subject crossover clinical trial that the speech is often perturbed after the treatment. Placement of maxillary long-bar IOD, no matter of palate coverage, produced a significantly higher percentage of sounds correctly than with IFD. Similar findings were published in other studies, where the IOD patients assessed speech with high ratings after the treatment (Heydecke et al., 2003b; Naert et al., 1998; Zitzmann & Marinello, 2000).

Placement of more implants seems to have a great role in maxilla, since the most studies included implant-retained hinging overdentures on four implants with the promising results (de Albuquerque et al., 2000; Naert et al., 1998). Some authors also presented cases with 5 to 6 inserted implants with high rating results (Fischer & Stenberg, 2006). The results indicate that the maxillary IOD supported by multiple implants may provide patients with better oral function than IFD treatment. (Heydecke et al., 2003b).

Many different types of attachments have been used for implants. For maxilla low number of studies was available. A bar showed satisfactory results and high patients ratings. Therefore, a use of a long-bar (de Albuquerque et al., 2000; Heydecke et al., 2003b) or just inter-implant bar attachment (Watson et al., 1997) was proposed as a reliable retention solution.

Furthermore, the 64.7% of the participants preferred the physiologic occlusion, while the 35.3% preferred the lingualized occlusion (Aarts et al., 2008). However, when the general satisfaction, general ability to chew and general function were analyzed together no significant differences between the occlusion concepts were observed.

Type of implant has been a focus of the study by Peñarrocha et al. (2007), where a patient satisfaction was compared between a group with zygomatic implant-supported IFD and the other group with conventional implants. General satisfaction was similar, but the patients in the zygomatic group demonstrated higher scores for esthetics.

The predictability of the loading protocols has been well documented, but only one study demonstrated patient satisfaction depending on the time of implant loading. A study by Fischer & Stenberg (2006) presented that the early loading protocol is a viable alternative to the standard protocol in the rehabilitation of the edentulous maxilla patients concerning the patient's point of view.

The general opinion is that the implants in the edentulous maxilla are a recommended treatment option, no matter if the IOD or IFD has been used as a prosthodontic suprastructure, especially for the patients that have a problem to adapt to CD (de Albuquerque et al., 2000; Heydecke et al., 2003b; Naert et al., 1998).

Outcome	Removable implant overdenture	Fixed implant denture
General satisfaction	<ul style="list-style-type: none"><li>- Very high ratings (Heydecke et al., 2003b; Naert et al., 1998; Watson et al., 1997)</li><li>- High ratings (Aarts et al., 2008; Watson et al., 1997),</li><li>- High improvement, ratings the same as for CD, no difference with and without palate (de Albuquerque et al., 2000)</li></ul>	<ul style="list-style-type: none"><li>- High satisfaction (de Bruyn et al., 1997; Fischer &amp; Stenberg, 2006; Peñarrocha et al., 2007),</li><li>- Very high ratings 3-years post treatment (de Bruyn et al., 1997),</li><li>- Significantly less satisfaction as with IOD (Heydecke et al., 2003b)</li></ul>
Esthetics	<ul style="list-style-type: none"><li>- Great difference between pretreatment and post treatment scores (Zitzmann &amp; Marinello, 2000),</li><li>- Very high ratings (Naert et al., 1998)</li></ul>	<ul style="list-style-type: none"><li>- Very high ratings 3-years post treatment (de Bruyn et al., 1997),</li><li>- Significantly lower ratings comparing to IOD (Heydecke et al., 2003b)</li></ul>
Chewing	<ul style="list-style-type: none"><li>- Very high ratings (Naert et al., 1998),</li><li>- Significantly better than CD (Heydecke et al., 2003b, 2004; Watson et al., 1997)</li></ul>	<ul style="list-style-type: none"><li>- 90% have optimal chewing (de Bruyn et al., 1997),</li><li>- High satisfaction (Heydecke et al., 2003b)</li></ul>
Cleaning	<ul style="list-style-type: none"><li>- Easier to clean compared to IFD (Heydecke et al., 2003b)</li></ul>	<ul style="list-style-type: none"><li>- Significantly harder to clean than IOD (Heydecke et al., 2003b)</li></ul>
Stability, Comfort	<ul style="list-style-type: none"><li>- Very high ratings (Naert et al., 1998; Watson et al., 1997; Zitzmann &amp; Marinello, 2000)</li></ul>	<ul style="list-style-type: none"><li>- Optimal for 90% of patients (de Bruyn et al., 1997)</li></ul>
Speech	<ul style="list-style-type: none"><li>- Better pronunciation than IFD (without difference with and without palate) (Heydecke et al., 2004),</li><li>- Very high ratings (Naert et al., 1998; Watson et al., 1997),</li><li>- Better speak quality compared to IFD (Heydecke, 2003b),</li><li>- Great difference between pretreatment and post treatment scores (Zitzmann &amp; Marinello, 2000)</li></ul>	<ul style="list-style-type: none"><li>- Significantly worse than IOD (Heydecke et al., 2003b)</li></ul>
Taste	<ul style="list-style-type: none"><li>- Great difference between pretreatment and post treatment scores (Zitzmann &amp; Marinello, 2000)</li></ul>	
Cost		<ul style="list-style-type: none"><li>- Treatment costs per unit were significantly higher than in IOD (Zitzmann &amp; Marinello, 2000)</li></ul>

Table 1. Edentulous Maxilla – treatment outcomes

4.2 Treatment option for the edentulous mandible

Until recently, the only option to treat edentulousness was by giving the patient removable CD. The main problem in the beginning was a poor fitting, but contemporary technical procedures resulted with their more precise fabrication and comfortable wearing.

Outcome	Removable implant overdenture	Fixed implant denture
General satisfaction	- Significant improvement (Aarts et al., 2008; Allen & Locker 2002; Allen et al., 2001; Boerrigter et al., 1995a, 1995b; Bouma et al., 1997; Cibirka et al., 1997; Cune et al., 2005, 2010; Davis & Packer, 1999; De Grandmont et al., 1994; Ellis et al., 2009; Fenlon et al., 2001; Geertman et al., 1996b; Heydecke et al., 2003, 2008; Kapur et al., 1998; MacEntee et al., 2005; Mericske-Stern et al., 2009; Naert et al., 1997, 1999; Pan et al., 2008; Pera et al., 1998; Raghoobar et al., 2003; Rashid et al., 2011; Stellingsma et al., 2003; Tang et al., 1997; Timmerman et al., 2004; Walton et al., 1997, 2002; Wismeijer et al., 1997) - 96% of the patients satisfied (Pan et al., 2007)	- Significant improvement (De Grandmont et al., 1994) - Very high ratings 3-years post treatment (Allen & Locker, 2002; de Bruyn et al., 1997; Gregory et al., 1990) - Significant improvement, confidence in themselves, part of their body (Blomberg, 1985; Walton et al., 2009;)
Esthetics	- Significant improvement (Cibirka et al., 1997; De Grandmont et al., 1994; Watson et al., 1997; Fenlon et al., 2002; Walton et al., 2002)	- Significant improvement (Blomberg, 1985; de Bruyn et al., 1997; De Grandmont et al., 1994; Walton et al., 2009;)
Chewing	- Significant improvement in chewing hard and soft foods (Allen & Locker, 2002) - Significantly better than CD (Awad et al., 2000; Geertman et al., 1996) - Improved chewing (Boerrigter et al., 1995a, 1995b; Cibirka et al., 1997; De Grandmont et al., 1994; Fenlon et al., 2002; Kapur et al., 1998; Meijer et al., 2001; Pera et al., 1998; Raghoobar et al., 2003; Rashid et al., 2011; Roumanas et al., 2003; Tang et al., 1997; Walton et al., 2002; Watson et al., 1997; Wismeijer et al., 1997)	- Optimal chewing function (Blomberg, 1985; De Grandmont et al., 1994; Gregory et al., 1990) - Problems decreased (de Bruyn et al., 1997; Walton et al., 2009) - Significantly better than CD (Allen Locker, 2002)
Cleaning	- Decisive factor in comparison to IFD (De Grandmont et al., 1994)	- Difficult cleaning in comparison to IOD (De Grandmont et al., 1994)

Outcome	Removable implant overdenture	Fixed implant denture
Stability, Comfort	<ul style="list-style-type: none"><li>- Good retention (with bar and ball attachment) (Naert et al., 1997; 1999)</li><li>- Two implants and ball attachments less satisfied than bar splinted implants (Timmerman et al., 2004)</li><li>- Improved comfort (Burns et al., 1995; Kapur et al., 1998; Meijer et al., 2001; Pan et al., 2007; Tang et al., 1997; Walton et al., 2002; Watson et al., 1997; Wismeijer et al., 1997)</li><li>- Bar improved comfort (Mericske-Stern et al., 2009)</li><li>- Better in long-bar overdenture supported by more implants (Tang et al., 1997)</li><li>- High comfort with ball (Rashid et al., 2011)</li></ul>	<ul style="list-style-type: none"><li>- Optimal (Blomberg, 1985; de Bruyn et al., 1997; Gregory et al., 1990; Walton et al., 2009)</li></ul>
Speech	<ul style="list-style-type: none"><li>- Significant improvement (Cibirka et al., 1997; De Grandmont et al., 1994; Rashid et al., 2011; Watson et al., 1997; Wismeijer et al., 1997;)</li></ul>	<ul style="list-style-type: none"><li>- Significant improvement (Blomberg, 1985; de Bruyn et al., 1997; De Grandmont et al., 1994; Walton et al., 2009;)</li></ul>
Cost	<ul style="list-style-type: none"><li>- More cost-effective than CD (Attard et al., 2006)</li><li>- No difference in cost between immediate and conventional loading protocol (Attard et al., 2006)</li></ul>	
OHRQoL	<ul style="list-style-type: none"><li>- Significant improvement (lower post-treatment OHIP scores) (Awad et al., 2000)</li><li>- High (Allen &amp; Locker, 2002; Allen et al., 2001, 2006; Attard et al., 2006)</li><li>- Better in long-bar overdenture supported by 4 implants than in two-implant hybrid bar overdenture (Tang et al., 1997)</li><li>- Significant improvement one-year after the treatment (Bouma et al., 1997; Kleis et al., 2010)</li><li>- Improved (Cibirka et al., 1997)</li><li>- Improved by 33% (Heydecke et al., 2005b).</li></ul>	<ul style="list-style-type: none"><li>- Significant improvement (OHIP49-31-point within group) (Allen &amp; Locker, 2002)</li><li>- Equally satisfied as IOD (Zani et al., 2009) (OHIP)</li></ul>

Table 2. Edentulous Mandible - treatment outcomes



Despite the great improvement in denture quality, poor retention of the mandible denture is still a great problem for many patients, especially in the patient with a great loss of alveolar bone volume, intolerance of the denture or chewing problems, that led to feelings of insecurity and inferiority and considerable psycho-social problems (Albrektsson et al., 1987). For this population a CD is unsatisfactory treatment.

Forty-four investigations have been published with evidence level I and II concerning the rehabilitation of the edentulous mandible with implant-supported complete dentures (Table 2.). All the publications found a higher level of satisfaction for IOD, while no article confirmed the same level of satisfaction as for CD treatment (Fig 4). Concerning the IFD treatment, all 7 publications agree that patient satisfaction is higher after the treatment (Allen & Locker, 2002; Blomberg, 1985; Blomberg & Lindquist, 1983; de Bruyn et al., 1997; De Grandmont et al., 1994; Gregory et al., 1990; Zani et al., 2009). Zani et al. (2009) assessed IFD treatment equally satisfactory as IOD treatment, while De Grandmont et al. (1994) determined cleaning as a decisive factor in comparison to IOD.

In the most of the articles new denture in the upper jaw has been produced (Awad et al., 2000; Cune et al., 2005; de Bruyn et al., 1997; De Grandmont et al., 1994; Heydecke et al., 2003; Roumanas et al., 2003; Tang et al., 1997), giving a more objective results of the mandibular IOD. Still, the better fitting of the new upper CD doesn't mean that the presence of any problems should be attributed to the lower IOD. Furthermore, most of the studies included control group with a lower CD (Allen et al., 2006; Awad et al., 2000; Cibirka et al., 1997; Geertman et al., 1996b; Heydecke et al., 2003; Kent & Johns, 1991; Kiyak, et al., 1990; Pan et al., 2008; Pera et al., 1998; Raghoobar et al., 2003; Roumanas et al., 2003) to compare the results and present the advantage of the IOD. Absence of the control group, like the study by Walton et al. (2009), may compromise the results, making them less objective and reliable.

Studies that compared implant-supported dentures with CD demonstrated higher patients' general satisfaction and OHRQoL after implant insertion (Aarts et al., 2008; Allen & Locker, 2002; Allen et al., 2001, 2006; Awad et al., 2000; Blomberg, 1985; Boerrigter et al., 1995a, 1995b; Bouma et al., 1997; Burns et al., 1995; Cibirka et al., 1997; Davis & Packer, 1999; De Grandmont et al., 1994; Ellis et al., 2009; Emami et al., 2009; Fenlon et al., 2002; Geertman et al., 1996a, 1996b; Gregory et al., 1990; Heydecke et al., 2003, 2005b, 2008; Kapur et al., 1998; Kleis et al., 2010; Meijer et al., 1999; Naert et al., 1997, 1999; Pan et al., 2008; Pera et al., 1998; Roumanas et al., 2003; Tang et al., 1997; Walton et al., 2002; Wismeijer et al., 1997). Based on two meta-analysis (Emami et al., 2009; Thomason, 2010) IOD treatment has been confirmed as more satisfying for edentulous patients than new CD, resulting with the improved OHRQoL. Still the magnitude of IOD effect stayed uncertain. Therefore, Emami et al. (2009) proposed inclusion of cost-effectiveness analyses to better assess the impact of conventional and implant treatments.

According to Heydecke et al. (2008), in IOD patients post treatment satisfaction meets the pretreatment expectation (especially in middle-aged patients), but it is not the case in CD group (Heydecke et al., 2003). This confirms that the patients have been informed about the advantages of the IODs. Kapur et al. (1998) demonstrated overall satisfaction as well as improved chewing and comfort. Therefore, he considered IOD for patients experiencing chronic irritation and/or chewing discomfort.

Since the implant therapy includes surgical pretreatment and higher cost, some patients refuse implants despite having problems with their old dentures (Ow et al., 1997). We also

have to consider that in the most of the cases the problem is not in dentures as a treatment option but the way the treatment has been done. Therefore we shouldn't eliminate the denture as a treatment option, instead to repeat the denture should be the first treatment option (Strassburger et al., 2006).

To verify the advantages of implants, an assessment of OHRQoL outcomes after IOD treatment has been done. Awad et al. (2000) and Allen et al. (2006) attempted to investigate the impact of implant treatment on OHRQoL (measured with OHIP questionnaire) and reported significant improvement among subjects who received IOD. In addition, Heydecke et al. (2005b) reported improvement of OHRQoL by approximately 33%, what justifies the difference in cost according to the author. Furthermore, a series of publications confirms the improvement of OHRQoL (Assunção et al., 2007; Awad et al., 2000, 2003b; Berretin-Felix et al., 2008; Boerrigter et al., 1995a, 1995b; Burns et al., 1994; Cibirka et al., 1997; Fenlon et al., 2002; Geertman et al., 1996; Heydecke et al., 2003; Kapur et al., 1998; MacEntee et al., 2005; Meijer et al., 1999, 2003; Melas et al., 2001; Pera et al., 1998; Raghoobar et al., 2003; Thomason et al., 2003; Walton et al., 2002; Wismeijer et al., 1997), while fewer studies concluded that there is no differences in OHRQoL between IOD and CD (Allen et al., 2001; Assunção et al., 2007; Bouma et al., 1997; Kapur et al., 1999; Kimoto & Garrett, 2005; Wismeyer et al., 1995).

The implant-prosthodontic treatment results also in improvement of retention and stabilization of dentures (Salonen, 1994), furthermore their function and OHRQoL (Allen et al., 2001; Att & Stappert, 2003; Awad et al., 2003; Heydecke et al., 2003). Some authors confirmed that the use of implant supported dentures provides more comfort in comparison to conventional ones (Heydecke et al., 2005). According to Boerrigter et al. (1995a, 1995b) the absence of the satisfactory stability and retention is the greatest problem of CD, and the reason why so many edentulous people are dissatisfied with their lower CDs. Resulting functioning problems, as well as other factors (denture quality, the small denture bearing area, previous denture experiences, the patient's personality and psychologic well-being) are also important problems why more and more patients are seeking for IOD treatment as a solution for their problems. After construction of a lower IOD general functional complaints significantly diminish, confirming the advantage of the IOD over the CD (Boerrigter et al., 1995a). A positive response to treatment was confirmed by the 96% of the patients that felt satisfied with new IOD and reported their fit comfortably (Pan et al., 2007). Concerning the sex differences, they remained in the CD group after the 12 months observation period, but in the IOD group the both, males and females, rated their satisfaction as equal (Pan et al., 2008).

De Grandmont et al. (1994) observed significant improvement after implant treatment and demonstrated higher scores (VAS scale) to both types of implant supported prostheses (IOD and IFD) than to their original CD for general satisfaction, as well as for the chewing, esthetic, cleaning and speech. Patients paid more attention to what they ate with the CD and much less using the implant-supported dentures because of the stability provided. Concerning the fit and retention again the implant-supported dentures were evaluated as better. Improving the stability and retention patients don't have to support their CD with the tongue and cheeks and use them for better pronunciation. Therefore, the speech was rated as better as well.

The most of the publications deal with mastication problems that greatly determine the general satisfaction with IOD. These implant-supported dentures offer the possibility of overcoming some of the limitations of CD in terms of chewing efficiency (Allen & Locker,

2002; Boerrigter et al., 1995a; Fenlon et al., 2002; Geertman et al., 1996; Rashid et al., 2011; Watson et al., 1997;). Subjects who received IOD reported significant improvement in chewing hard and soft foods, but still 30–50% of them avoided eating hard food. This suggests that successful prosthetic rehabilitation improved chewing ability does not necessarily result in a satisfactory food selection and diet (Allen & Locker, 2002). Roumanas et al. (2003) proposed dietary counseling as a part of implant and complete denture therapy. After the adaptation period to new IOD, patients only consumed less difficult-to-chew foods than with their original CD, what was more frequent in lower jaw (Roumanas et al., 2003).

The superiority of the implant treatment in patients with atrophic ridge has been a focus of certain number of studies. At the 1-year evaluation study by Boerrigter et al. (1995b) IODs were compared to CDs, as well as to CDs made after a vestibuloplasty and deepening of the floor of the mouth. Results indicated vestibuloplasty as a more satisfactory solution for denture-related problems than CD, but still IOD group showed better scores and superior results. In his multicentre randomised clinical trial (RCT) Boerrigter et al. (1995a) once again confirmed dental implants to provide a more satisfactory solution to denture-related problems for patients with a severely resorbed mandible. These findings were confirmed in the study by Pera et al. (1998), who reported high satisfaction and masticatory efficiency after implant-anchorage of the denture in atrophic ridge. Furthermore, the study by Bouma et al. (1997) demonstrated that the denture satisfaction was more favorable in the IOD group when compared to the preprosthetic surgery group to enlarge the denture-bearing area. One year after treatment, all three dental treatment modalities had a comparably positive effect on dental health-related quality of life (Wismeyer et al., 1995). Therefore, the implant-retained overdentures are a favourable treatment modality for edentulous patients with lower denture problems (Raghoobar et al., 2003).

Several studies concerning the type of implant are available. Geertman et al. (1996a) observed the differences between the transmandibular and the endosseous implant with respect to satisfaction, complaints, and subjective chewing ability, and found no statistical significance. Similar findings were presented by Meijer et al. (2001). Analyzing the advantage of these implants over the augmentation of the mandible followed by four endosseous implants, the 1-year evaluation study in extremely resorbed mandible found no difference between these three treatment modalities. However, in terms of discomfort and pain during the augmentation using an autologous bone graft from the iliac crest followed by inserting four endosseous implants appeared the least favorite option (Stellingsma et al., 2003).

Implant immediate and early loading protocols are becoming more and more popular because of the shorter treatment period, no matter of fixed or removable denture suprastructure. The advantages are less appointments, faster treatment and reduction of costs. Attard et al. (2006) compared different loading protocols with measured outcomes, such as degree of satisfaction and impact on quality of life. Significant improvement in perceived oral health status has been observed for both loading protocols (immediate and conventional loading), what confirms IOD as a more cost-effective treatment than CD (Attard et al., 2006). No difference in time cost was observed and the immediate protocol was not confirmed as a cheaper alternative.

In the most of the investigations 2 implants in the interforaminal region have been inserted supporting IOD (Assunção et al., 2007; Cune et al., 2010; Ellis et al., 2009; Meijer et al., 2001; Mericske-Stern et al., 2009; Naert et al., 2004; Rashid et al., 2011; Timmerman et al., 2004;).

Most of the articles confirmed this treatment option as a reliable and satisfactory that improves OHRQoL of patients, proposing this option as a standard procedure. Measured by OHIP questionnaire higher values were detected in implant patients (Awad et al., 2000; Heydecke et al., 2003b, 2008; Kleis et al., 2010). In some studies more implants were inserted, like four or five (De Grandmont et al., 1994; Stellingsma et al., 2003), but insertion of more implants doesn't seem to further increase patients' satisfaction (Geertman, 1996b). Meijer et al. (2001) demonstrated that putting 4 implants no difference in comparison to 2- implant systems will occur.

When the type of retention was analyzed, it was observed that in the most of the publications a bar or a ball were used as an attachment connection to overdenture. The most used treatment option was two-implant IOD retained by ball attachments and single- or triple-bar. Some studies suggest that a mandible overdenture retained by 2 implants with a single bar may be the best treatment strategy for edentulous people with atrophic ridges (Naert et al., 2004; Timmerman et al., 2004), while some authors presented the results of high satisfaction with the new dentures no matter of the attachment connection (a bar or a ball) (Cune et al., 2010; MacEntee et al., 2005; Naert et al., 1997, 1999).

The widely accepted treatment option is insertion of 4 implants and overdenture retained by a cast bar with extracoronary attachments, what resulted with good denture fit (Pan et al., 2007). According to Wismeijer et al. (1995) no significant difference was found between the three treatments strategies (two implants with ball attachments, two implants with an interconnecting bar, and four interconnected implants); therefore, the simple implant treatment such as an overdenture retained by two ball attachments author suggested as sufficient treatment. Recently, high and comparable satisfaction has been presented inserting a single midline implant; therefore this option was suggested as an alternative to the customary two-implant overdenture for maladaptive denture patients (Walton et al., 2009).

Magnets as an attachment system have been presented in limited number of publications. Although they provide viable treatment options and high general satisfaction (Davis & Packer, 1999; Naert et al., 1997, 1999;), still the low retention force (Naert et al., 1997, 1999) and unsatisfactory comfort (Naert et al., 2004) makes it the last desirable option. This attachment option was included in the study by Cune et al. (2005). The results showed that patients strongly preferred bar-clip (10/18 subjects) and ball-socket attachments (7/18 subjects) over magnet attachments (1/18 subjects) (Cune et al., 2005). Similar results were presented by Burns et al. (1995) and Ellis et al. (2009), i.e. a strong preference for the ball over the magnets. The magnetic attachment has a low resistance to lateral forces, and the subsequent immediate loss of retention might be the reason for such a low satisfaction with this type of retention.

Locator® attachment system has been recently used in dentistry, but there is a lack of clinical studies on this attachment system for two-implant-retained overdentures in the edentulous mandible. Only one study compared it with two other traditional designs and no significant difference in the patients' OHRQoL was found between them (Kleis et al., 2010).

Tang et al. (1997) compared a within-subject crossover clinical trial for two forms of removable prostheses which are frequently prescribed for the edentulous mandible: a long-bar overdenture supported by 4 implants and a two-implant hybrid bar overdenture. Subjects rated significantly better general satisfaction, quality of life, stability, retention,



comfort, esthetics and chewing using long-bar overdenture. This was expected since the two implant hybrid denture transfers a part of the occlusal forces on the bearing area, while the longer bar accepts almost all forces. To establish an adequate occlusal table the distal cantilever extensions (10 to 20 mm) could be created (De Grandmont et al., 1994), or U-shaped triple-bar construction with 2 cantilever extensions (Meijer et al., 2001). These options were confirmed as reliable ones and rated with high satisfaction by the patients.

A limited number of studies confirmed improvement after IFD treatment (Allen & Locker, 2002; Blomberg, 1985; Cibirka et al., 1997; de Bruyn et al., 1997; De Grandmont et al., 1994; Gregory et al., 1990; Walton et al., 2009). The majority of them state that there has been a significant improvement in their lives, that they have regained confidence in themselves, and that, in contrast to a conventional denture, they accept the IFD as part of their body. High percentage of patients (90%) rated comfort and stability as «optimal» (Blomberg, 1985; Walton et al., 2009). There was considerable evidence of improved well-being of patients, who felt more secure following treatment and, as a result, their personal and social relationships improved (Gregory et al., 1990).

The most clinicians believe that IFD constitute generally the treatment of choice for edentulous patients, providing better comfort (fit), stability and retention; therefore providing better function and esthetics. On edentulous mandible patients this assumption does not appear to hold. De Grandmont et al. (1994) demonstrated in a within-subject cross-over trial that the scores given for both types of prostheses did not differ with regard to general satisfaction, esthetics, and ability to speak and to chew. This confirms IOD as a equally satisfactory option (Zani et al., 2009), concerning the cleaning even the superior to IFD (De Grandmont et al., 1994). Similar results were published by Feine et al., (1994) in their within-subject cross-over clinical trial, where they observed that IOD patients rated ease of cleaning as the most important factor, while the IFD group rated stability and ability to chew as significantly better than with IOD. Perhaps the reason is construction that allows easier cleaning but also deposition of food, since a 2-3-mm relief between the residual ridge and the IFD was left free. Feine et al. (1998) concluded also that about half of all patients preferred IOD to IFD.

When comparing chewing outcome the most clinicians would prefer IFD. According to De Grandmont et al. (1994) no significant differences between the IOD and IFD were detected except for the difficulty of chewing carrot, apple, and sausage, which were rated with higher values in IFD patients. The results confirm the clinical impression that IFD are more efficient than IOD for eating harder types of foods. Despite this result level of general satisfaction with the IFD wasn't assessed as higher. In other words patients in this within-subject cross-over clinical trial were equally satisfied with both types of implant-supported dentures, despite the general clinical belief.

Based on the findings of these studies, the general conclusion is that mandibular overdentures are more satisfactory than conventional dentures, and 90% of patients indicated that they were ready to repeat the treatment if necessary (de Bruyn et al., 1997).

#### **4.3 Treatment options for the partially edentulous patients**

Dental implants are expanding their use among partially edentulous patients. However, whether implants can improve the OHRQoL of these patients has not been sufficiently examined (Table 3.). Kuboki et al. (1999) presented higher OHRQoL levels for dental implant patients than those with removable partial denture or no restoration. The results of



this study confirmed the ability of IFD restoration to promote oral condition related quality of life of unilateral mandibular distal extension edentulism.

Outcome	Fixed implant partial denture
General satisfaction	- 90% satisfied (Kapur, 1991), - Highly satisfied (de Bruyn et al., 1997; Farzad et al., 2004; Schropp et al., 2004; Yi et al., 2001)
Esthetics	- Improved and satisfactory, the same as in the control group with natural teeth (Yi et al., 2001) - High (de Bruyn et al., 1997) - 7% better than RPD (Kuboki et al., 1999)
Chewing	- 28% better than RPD (Kuboki et al., 1999) - Improved and satisfactory, the same as in the control group with natural teeth (Yi et al., 2001) - High (de Bruyn et al., 1997; Kapur, 1991)
Cleaning	- More difficult than RPD (Feine et al., 2002) - Satisfactory (de Bruyn et al., 1997; Kapur, 1991)
Stability, Comfort	- 14% better than RPD (Kuboki et al., 1999) - Improved and satisfactory, the same as in the control group with natural teeth (Yi et al., 2001) - Problem eliminated (de Bruyn et al., 1997) High (Kapur, 1991)
Speech	- 10% better than RPD (Kuboki et al., 1999) - Improved and satisfactory, the same as in the control group with natural teeth (Yi et al., 2001) - Satisfactory (de Bruyn et al., 1997; Kapur, 1991)
OHRQoL	- Significant improvement in shortened dental arch (OHIP) (Kuboki et al., 1999)

Table 3. Partially Edentulous Jaw - treatment outcomes

Wearing dentures is often a not pleasing experience for the patients because of unsatisfactory fit and stability. As a result of unsatisfactory retention comfort problems occur. Therefore, Kapur (1991) observed that the improvement in social life has been better after IFD treatment. The results of de Bruyn et al. (1997) also demonstrated high patient’s satisfaction since comfort problems diminished after IFD treatment. Concerning the cleaning, studies demonstrated more difficult cleaning with IFD than with although the cleaning was easier in removable partial denture group (Feine et al., 2002; Kapur, 1991). High VAS values regarding satisfaction were also presented for the implant-supported crown (Schropp et al., 2004). Improved and satisfactory oral function after rehabilitation has been confirmed also in periodontally compromised patients (Yi et al., 2001). Comparing the results between the IFD group and dentate group, no significant difference was observed for mastication, phonetics, chewing comfort and aesthetics. Some studies published in this field

examined difference in satisfaction depending of the loading protocol. In general, the patients were highly satisfied with the outcome of the both loading protocols (early and delayed) (Schropp et al., 2004; Schropp & Isidor, 2008). Still, the appearance with the IFD was assessed as significantly greater in the immediate group than in the delayed group (Schropp et al., 2004).

The results of the analyzed publications allow us to conclude that patients were generally very satisfied with IFD treatment outcome in the posterior mandible (Farzad et al., 2004; Kapur, 1991). Therefore, IFD treatment is proposed as a reliable treatment option in partially edentulous patients.

## 5. Conclusion

This review attempted to identify published articles describing the effect of implant and prosthodontic treatment on patient satisfaction and OHRQoL outcomes. The data and conclusions of the high level evidence publications were collected and summarized with the aim to establish the general treatment benefits in comparison to other therapy solutions and to confirm it as a reliable and superior treatment option. Patient-centered approaches to the assessment of treatment efficacy are highly relevant to today's prosthodontist, whose goals are the improvement of function and quality of life for their patients. The implementation of implant therapy has further induced the number of studies to assess the patient's opinion about this treatment option. It was hypothesized that the number of studies based on high-level evidence, using patient-based outcomes in some areas is small and that some treatment possibilities haven't been investigated.

The high number of publications from this area confirms progression in the last decades. Despite a huge number of OHRQoL studies, only few of them assessed specific prosthodontic treatments in edentulous areas and particular effects on the improvement of the OHRQoL in elderly population. Most studies on the OHRQoL investigated similar types of dentures (egg mandible 2 implants and bar or ball) and include middle-age groups. Methodically more specified studies are required to assess the outcomes of some specific fields of OHRQoL.

While improvement of OHRQoL has been reported for both treatment options (IOD and IFD), it is also important to demonstrate their superiority over the conventional treatments for every edentulous possibility in completely or partially edentulous arch. Therefore, all studies should include control group and patients should be observed for a longer period of time.

The effect of the technical correctness and quality of prosthetic restorations has also been scarcely investigated. This should be included as well to properly assess the advantages and cost-benefit of a specific treatment. Furthermore, to establish a direct comparison between the studies it would be necessary to standardize the sampling methodologies, meaning questionnaires and follow-up periods.

Within the limitation of the literature review, it can be concluded that most of the studies confirmed higher patient satisfaction and OHRQoL improvement using 2 implant bar and ball attachment mandibular IOD in comparison with CD. Four implants connected by a bar were showed as a reliable option for edentulous maxilla. In contrast to common belief, based on the results collected, placing IFD has not been confirmed as a superior treatment to IOD. This result was not expected, since the IFD treatment was stated as most likely to be physiologically and psychologically incorporated into the oral cavity.

Since most of the information available is limited to outcomes of IOD therapy in mandibular edentulous jaw, more randomized controlled trials studies are needed to obtain IFD effectiveness data, regardless of the jaw and number of the teeth that are missing. The data presented should help future researchers to develop and improve study designs with broader outcome measures that will support dentist to make appropriate therapeutic decisions for every individual patient.

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