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Conventional and early loading of two-implant supported mandibular overdentures. A systematic review

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SUMMARY

Objectives. Implant loading time is considered to influence the treatment outcomes. Number of experimental studies have shown that implant loading up to 3 months can produce equally satisfactory results. However, research results in this area are not consistent. The purpose of the study was to investigate the influence of conventional and early loading of two-implant supported mandibular overdentures on treatment outcomes.

Methods. The articles from 1985 to 2007 in English related to the topic were identified. Totally 221 (214 online and 7 printed) primary articles were detected. Eight articles were selected for data extraction. Implant survival and success rates, periimplant parameters, prosthetic maintenance and patient satisfaction were considered.

Results. Implant success rate ranged from 83% to 100% in conventional loading group and from 71% to 100% in early loading group. During the first year in conventional group, the marginal bone loss ranged from 0.35 to 0.91 mm, during the second year – from zero to 0.2 mm, whereas in early loading group these intervals were 0.12-1 mm and 0-0.15 mm, respectively. Comparing averaged probing depth values at different time periods, it could be noticed that around conventionally loaded implants probing depth slightly decreased (from 1.62 mm to 1.56 mm), while around early loaded implants – increased from 1.7 mm to 1.82 mm.

Conclusions. Considering implant success rates and peri-implant parameters early loading protocol produces equal outcomes as with conventional loading. More well designed studies are needed to further substantiate the early loading protocol.

Key words: mandible, implant, overdenture, loading, systematic review.

INTRODUCTION

Different dynamics of edentulism rate are predicted in Europe and United States. It is expected that edentulism rate will increase in United States[1], however it was reported by Mojon et al, that falling rates of edentulism in Europe will be large enough to affect future patterns of treatment [2]. As treatment needs may depend on health care access, social factors, technological possibilities, attitudes among both health care providers and the patients it is very difficult to estimate it [3]. Most of the edentulous people wearing complete dentures have difficulty performing two of the essential tasks of life, eating and speaking, therefore quality of life in edentulous population is significantly decreased [4].

The validity of two-implant supported mandibular overdentures was confirmed by multiple randomized clinical trials [5, 6]. Various factors such as patient age, type of implants, height of residual ridges, occlusion factors, type of retainer etc were addressed as having impact on success and longevity of the implant supported mandibular overdentures [7-10].

Implant loading time is considered to influence the treatment outcomes as well. According to conventional protocol, 2 weeks after surgery the patients are not allowed to wear their mandibular

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dentures and the healing time of at least 3 months are required before connection of the overdenture to the implants [11, 12]. Traditionally one or two-stage approach can be employed. However, number of experimental studies have shown that implant loading up to 3 months can produce equally satisfactory results in edentulous anterior mandible [13, 14]. Increased bone-to-implant contact at earlier healing times with newly designed implant surfaces were reported [15]. Immediate (up to 2 days after surgery) and early (up to 3 months after surgery) loading protocols were proposed. Due to reduced overall treatment time, discomfort, high patient acceptance and better function they are gaining wider acceptance. Consequently, implant manufacturers extensively market one-piece implants for mandibular implant supported overdentures.

Nonetheless, clinical recommendations often are derived from poorly designed clinical studies lacking appropriate randomization, number of subjects and satisfactory follow-up periods [16, 17]. Therefore, research results in this area are not consistent and sometimes contradictory.

Considering available number of studies addressing the topic, it was decided to summarize currently present evidence on the implant-supported mandibular overdentures with conventional and early loading protocols. The purpose of the study was to investigate the influence of conventional and early loading of two-implant supported mandibular overdentures on the following treatment outcomes:

1. Implant success rate;
2. Peri-implant parameters;
3. Repair and adjustment of overdentures;
4. Patient satisfaction.

MATERIALS AND METHODS

Assessment of potentially relevant literature and its size was achieved via searching for existing reviews and primary studies relevant to a review's objectives. The articles from 1985 to 2007 in English related to the topic were identified in the online databases, manually and by other means (search of dissertation thesis, contacting manufacturers etc.). Clinical trials considering treatment of fully edentulous patients by implant-supported overdentures comparing conventional and early loading strategies were identified. Patients who received two implants in the mandible with minimum of one-year follow-up after functional loading were considered.

All attempts were made to address the following input variables:

1. Loading protocol;
2. Surgery technique;
3. Type of implants;
4. Implant length;
5. Type of attachment.

Search strategy

Free text terms alone or in combination with controlled vocabulary were used to search electronic bibliographic databases: MEDLINE/Pubmed, EMBASE and CCTR (The Cochrane Controlled Trials Register). The Internet search was done in a systematic way using beta version of meta-search engine – Google Scholar. Last online search was conducted on 15th of November 2007. Highly sensitive search strategy instead of specific was used to detect relevant randomized clinical trials (RCTs), controlled trials (CTs) and cost-effectiveness analyses (CEAs) comparing conventional and early loading protocols. Manual search was conducted and involved peer-reviewed publications related to the topic, reference lists of relevant primary and review articles and conference proceedings. An attempt has been made into obtaining otherwise unpublished research in the databases of dissertations and theses. Around 100 implant manufacturers were also contacted (11 of them responded).

Study selection

Totally 221 (214 online and 7 printed) primary articles were identified. One reviewer scanned all unmasked articles, and 201 irrelevant studies were excluded from the further review process. Potentially relevant titles and abstracts (n=20) were provisionally included for consideration on the basis of full text articles. Full text articles were obtained from on-line and printed sources.

Following inclusion criteria were applied: edentulous mandible, two mandibular implants, studies comparing conventional and early loading protocols, RCTs, CTs and CEAs. Exclusion criteria were: clinical trials without control group, 1 or more than 2 mandibular implants, grafting procedures and irradiated jaws.

One reviewer applied inclusion and exclusion criteria, and after unmasked assessment of studies 9 articles remained for further review process. Study selection process was documented giving detailed reasons for inclusion and exclusion.

Quality assessment

Quality assessment process was performed by one reviewer. The validity of the selected studies

was checked against biases according to principles published by "The Cochrane Collaboration": randomization and allocation concealment in order to avoid selection bias (recorded as adequate, unclear, inadequate and not used); blind outcome assessment in order to avoid detection bias (recorded as yes, no, unclear and not possible); and completeness of follow-up in order to avoid attrition bias (clear explanation for withdrawals and drop-outs in each treatment group recorded as yes and no) [18]. If all criteria were met, study was considered as having a low risk of bias; if one or more criteria were partially met, study was considered as having moderate risk of bias; if one or more criteria were not met – high risk of bias mark was given. However, following quality assessment one study [19] was excluded from further analysis due to selection bias (control group was comprised from historical cohort of patients). As a result, 8 articles were selected for data extraction (Table 1). Each article was checked for inclusion/exclusion criteria, type of intervention, allocation concealment, balanced allocation to test and control groups and follow-up.

Data extraction process

The following data were recorded to special data extraction forms: date of the publication, methods of interventions, number of participants at the baseline and each follow-up period, loading time, implant survival and success rates, status of maxillae, implant stability, periimplant parameters, patient satisfaction and maintenance. Some of the study characteristics according to the loading protocol are presented in Table 2. As for periimplant parameters marginal bone loss (MBL), mobility, modified plaque (mPI), gingival (mGI) and bleeding (mSBI or BoP) indexes and probing depth (PD) were considered. Only one of the selected studies has used panoramic images to evaluate MBL [20]. However, as MBL data in this study was not properly presented (only inaccurate descriptions in text and figures), it was impossible to extract it. All other studies used intraoral radiographs, therefore, there was no need

Table 1. Characteristics of the included studies

Authors, Year	Type of study	Groups, subjects	Inclusion	Intervention	Outcome	Allocation concealment	Follow-up (months)	Completeness to follow-up
Roynesdal et al, 2001	RCT	C=10 E=11	≥60 y Good primary stability	ITI (TPS), ball attachments	MBL, Periotest, Satisfaction, BoP	Not used	Baseline, 3, 6, 12, 24	90.5 %
Payne et al, 2002	RCT	C=12 E=12	55-80 y 13-15 mm residual bone height, no type IV bone	ITI (SLA), ball attachments	MBL, Periotest, abutment height, PD, mPI, mGI keratinized mucosa width	Adequate	Baseline, 12, 24	92%
Tawse-Smith et al, 2002	RCT	C=24 E=24	55-80 y 13-15 mm residual bone height, no type IV bone	Sterioss (machined)=24, Southern (roughened)=24, ball attachments	MBL, Periotest, abutment height, PD, mPI, mSBI, keratinized mucosa width	Adequate	Baseline, 12, 24	88%
Payne et al, 2003	RCT	C=12 E=12	55-80 y 8-15 mm residual bone height, no type IV bone	ITI (SLA)=12 Southern (roughened)=12, ball attachments	MBL, Periotest, abutment height, PD, mPI, mSBI, keratinized mucosa width	Not used	Baseline, 12	96%
Turkyilmaz et al, 2006a	RCT	C=10 E=10	≥50 y, 15 mm implants	Branemark (TiUnite), ball attachments	Appointments, time, adjustments, repairs	Unclear	Baseline, 1, 3, 6, 9, 12	N/a
Turkyilmaz et al, 2006b	RCT	C=10 E=10	≥50 y, 15 mm implants	Branemark (TiUnite), ball attachments	MBL, RFA	Unclear	Baseline, 1, 3, 6, 9, 12	N/a
Turkyilmaz et al, 2006c	RCT	C=13 E=13	≥50 y, 15 mm implants	Branemark (TiUnite), ball attachments	MBL, RFA, mPI, PD, mBI, mGI	Unclear	Baseline, 6, 12, 18, 24	100%
Smet et al, 2007	CT	C=10 E=10	Edentulous for ≥3 months, 13 mm 3.75-4 mm implants	Branemark (n/a), ball attachments	MBL, Periotest, bite force	Not used	Baseline, 1, 12	90%

C – conventional, E – early, MBL – marginal bone loss, BoP – bleeding on probing, PD – probing depth, mPI – modified plaque index, mSBI – modified sulcus bleeding index, GI – gingival index, RFA – resonance frequency analysis.

to adjust measured MBL in selected studies. Implant mobility was recorded as Periotest or RFA ISQ (Resonance frequency analysis, Implant stability quotient) values. One study [20] has used BoP, other three [13, 21, 22] used mSBI to record the bleeding. Where applicable, patient satisfaction score and maintenance events were recorded. All attempts were made to extract the data at 1 year and 2 year follow-up periods.

Description of studies

Out of 221 primary studies 8 remained for the systematic review. The majority of the studies (201) was rejected based on title and abstract review. Further 12 studies were rejected after careful evaluation of full texts as well as quality assessment. From 8 selected studies, 7 were concerned with comparison of conventional and early loading protocols. One study [23] compared early loading protocols with different implant systems. Considering selected studies, 3 implant systems were used to support mandibular dentures (Nobel Biocare, Straumann and Southern Implants), however, implant surface characteristics were considerably different. The loading time in conventional loading group ranged from 3 to 4 months, in early loading group – from 1 to 6 weeks. Regarding maxillae status, all patients in selected studies except one in conventional loading group [24] had edentulous maxillae. Only two-implant supported mandibular

Table 2. Characteristics of the included studies according to the loading protocol

	Authors, Year	Subjects	Implants	Loading time	Maxilla	MBL	Mobility	Plaque	Probing	Bleeding	Satisfaction	Maintenance
Conventional (control)	Roynesdal et al, 2001	10	ITI (TPS)=20	3 mo	N/a	Panoramic	Periotest	-	-	BoP	+	-
	Payne et al, 2002	12	ITI (SLA)=24	3 mo	CD	Intraoral	Periotest (1y) RFA (2y)	mPI	PD	-	-	-
	Tawse-Smith et al, 2002	24	Sterioss (machined)=24, Southern (rough)=24	3 mo	CD	Intraoral	Periotest	mPI	PD	mSBI	-	-
	Turkyilmaz et al, 2006a	10	Branemark (TiUnite)=20	3 mo	CD	-	-	-	-	-	-	+
	Turkyilmaz et al, 2006b	10	Branemark (TiUnite)=20	3 mo	CD	Intraoral	RFA	-	-	-	-	-
	Turkyilmaz et al, 2006c	13	Branemark (TiUnite)=26	3 mo	CD	Intraoral	RFA	mPI	PD	mSBI	-	-
	Smet et al, 2007	10	Branemark (not reported)=20	4 mo	CD=8, ND=2	Intraoral, CT	Periotest	-	-	-	-	-
Early (test)	Roynesdal et al, 2001	11	ITI (TPS)=22	2-3 w	N/a	Panoramic	Periotest	N/a	N/a	BoP	+	N/a
	Payne et al, 2002	12	ITI (SLA)=24	6 w	CD	Intraoral	Periotest (1y) RFA (2y)	mPI	PD	mSBI	N/a	N/a
	Tawse-Smith et al, 2002	12	Sterioss (machined)=24, Southern (rough)=24	6 w	CD	Intraoral	Periotest	mPI	PD	mSBI	-	-
	Payne et al, 2003	24	ITI (SLA)=24 Southern (rough)=24	2 w	CD	Intraoral	RFA	mPI	PD	mSBI	-	+
	Turkyilmaz et al, 2006a	10	Branemark (TiUnite)=20	1 w	CD	-	-	-	-	-	-	+
	Turkyilmaz et al, 2006b	10	Branemark (TiUnite)=20	1 w	CD	Intraoral	RFA	-	-	-	-	-
	Turkyilmaz et al, 2006c	13	Branemark (TiUnite)=26	1 w	CD	Intraoral	RFA	mPI	PD	mSBI	-	-
	Smet et al, 2007	10	Branemark (not reported)=20	1 w	CD	Intraoral, CT	Periotest	-	-	-	-	-

mo – months, CD – complete denture, CT – computerized tomography.

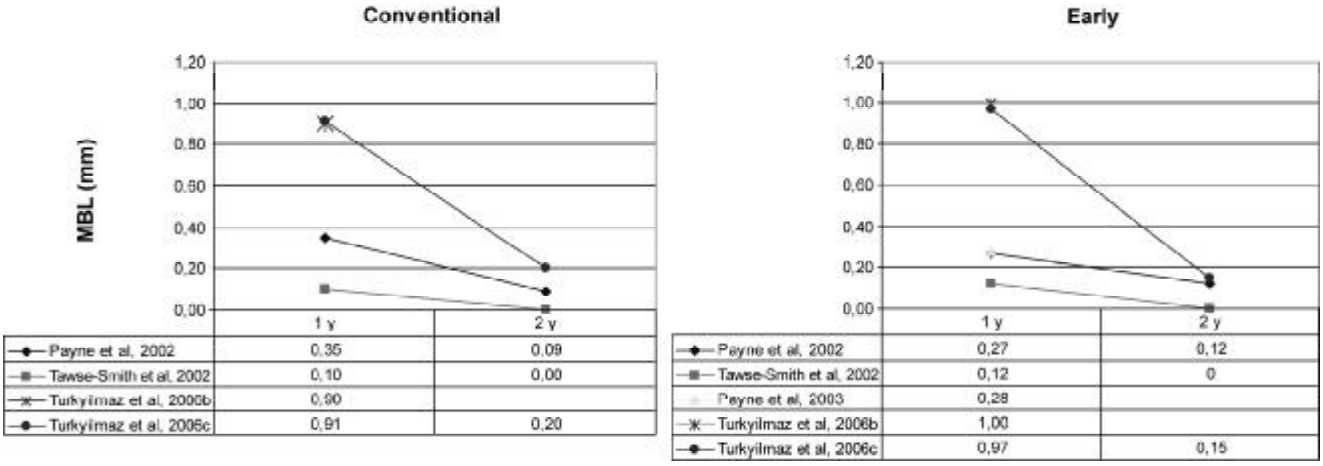

Fig. 1. Marginal bone loss (MBL) with conventional and early loading protocols at 1-year and 2-year follow-ups

overdentures were considered in this review. Selection process has failed to identify any study of appropriate quality on immediate loading of two mandibular implants with overdentures: several studies failed to pass quality assessment stage [25, 26]. Studies investigating treatment outcomes with immediate loading of four-implant supported mandibular overdentures were excluded from this review [27-29].

Regarding the type of the attachment all studies were highly homogenous – only ball attachments were used. Only one study evaluated patient satisfaction [20], and another one investigated mandibular overdenture maintenance with different loading protocols [30]. Follow-up rates varied from 88% to 100%. Combined patient sample size was 191 (conventional loading – 89, early loading – 102).

RESULTS

Implant survival, success and mobility

Considering results of included studies high implant survival and success rates could be noticed (Table 3). The rate of implant survival was calculated in percentages considering total number of inserted implants. Implant survival rate was high, except Smet et al. study where 2 implants were lost in early and 2 ones in delayed loading groups (90% survival) [24] and Tawse-Smith et al, where 71% survival in early loading group was reported. Implant success rate ranged from 83% to 100% in conventional loading group and from 71% to 100% in early loading group.

Two studies have reported 1-year and 2-year implant mobility results [21, 23]. However, Payne

Table 3. Implant survival and success rates with conventional and early loading protocols

	Authors, Year	Implants (surface)	Loading time	Survival (success)%
Conventional (control)	Roynesdal et al, 2001	ITI (TPS)=20	3 mo	100 (N/a)
	Payne et al, 2002	ITI (SLA)=24	3 mo	100 (91.5)
	Tawse-Smith et al, 2002	Sterioss (machined)=24,	3 mo	96 (87.5)
		Southern (rough)=24		100 (83.3)
	Turkyilmaz et al, 2006a	Branemark (TiUnite)=20	3 mo	100 (100)
	Turkyilmaz et al, 2006b	Branemark (TiUnite)=20	3 mo	100 (100)
	Turkyilmaz et al, 2006c	Branemark (TiUnite)=26	3 mo	100 (100)
	Smet et al, 2007	Branemark (not reported)=20	4 mo	90 (N/a)
Early (test)	Roynesdal et al, 2001	ITI (TPS)=22	2-3 w	100 (N/a)
	Payne et al, 2002	ITI (SLA)=24	6 w	100 (100)
	Tawse-Smith et al, 2002	Sterioss (machined)=24,	6 w	70.8 (70.8)
		Southern (rough)=24		100 (100)
	Payne et al, 2003	ITI (SLA)=24	2 w	100 (91.6)
		Southern (rough)=24		100 (100)
	Turkyilmaz et al, 2006a	Branemark (TiUnite)=20	1 w	100 (100)
	Turkyilmaz et al, 2006b	Branemark (TiUnite)=20	1 w	100 (100)
	Turkyilmaz et al, 2006c	Branemark (TiUnite)=26	1 w	100 (100)
	Smet et al, 2007	Branemark (not reported)=20	1 w	90 (N/a)

mo – months, w – weeks.

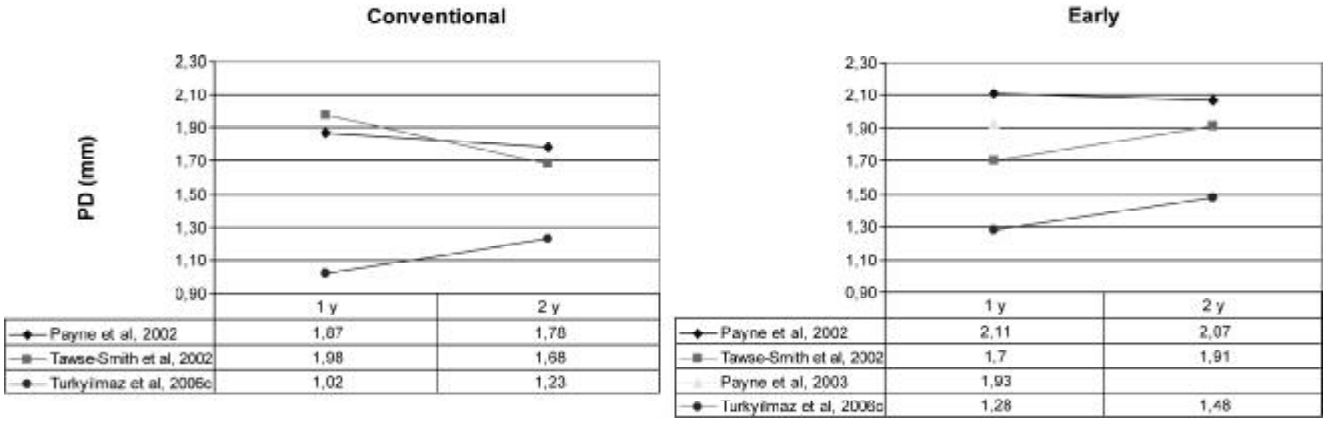

Fig. 2. Probing depth (PD) values with conventional and early loading protocols at 1-year and 2-year follow-ups

et al used Periotest at the 1-year follow-up and RFA ISQ at the 2-year follow-up, therefore it was difficult to compare implant mobility at these periods. According to Tawse-Smith et al after 1 year Periotest values in conventional group were -3.84 compared to -4.12 in early one; after 2 years these values were -4.52 and -4.74, accordingly. Increase of negative values is indicating good stability as well as osseointegration in both groups. Turkyilmaz et al in two studies measured implant stability using RFA method. After 1 year ISQ values were equal in both conventional and early loading groups – 76.4, however, after 2 years ISQ values were 75.2 and 76.7, respectively.

Peri-implant parameters

The peri-implant outcome data was extracted from 8 RCTs with follow-up length ranging from 1 to 24 months. Studies comparing conventional and early loading protocols reported higher MBL at 1-year follow-up compared with 2-year follow-up. During the first year in conventional group, the MBL ranged from 0.35 to 0.91 mm, during the second year – from zero to 0.2 mm, whereas in early loading group these intervals were 0.12-1 mm and 0-0.15 mm, respectively (Fig. 1). Probing depth, mPI, mGI, mSBI data are presented in Figures 2-5. Comparing averaged probing depth values at different time periods, it could be noticed that around conventionally loaded implants probing depth values slightly decreased (from 1.62 mm to 1.56 mm), while around early loaded implants – increased from 1.7 mm to 1.82 mm. Conflicting results were obtained regarding modified plaque index. Two studies have reported increase in mPI values at the 2-year follow-up in both, conventional and early loading groups: 50% and 43% respectively [21, 22]. However, according to Payne et al results, in conventional loading group mPI decreased by 38% and by 63% in early one [23]. Two studies have reported on gingival indexes. Similarly as with mPI, Turkyilmaz et al reported mGI increase (15%), while Payne et al reported 40% decrease. The tendency of increasing mSBI values was observed in all studies and in

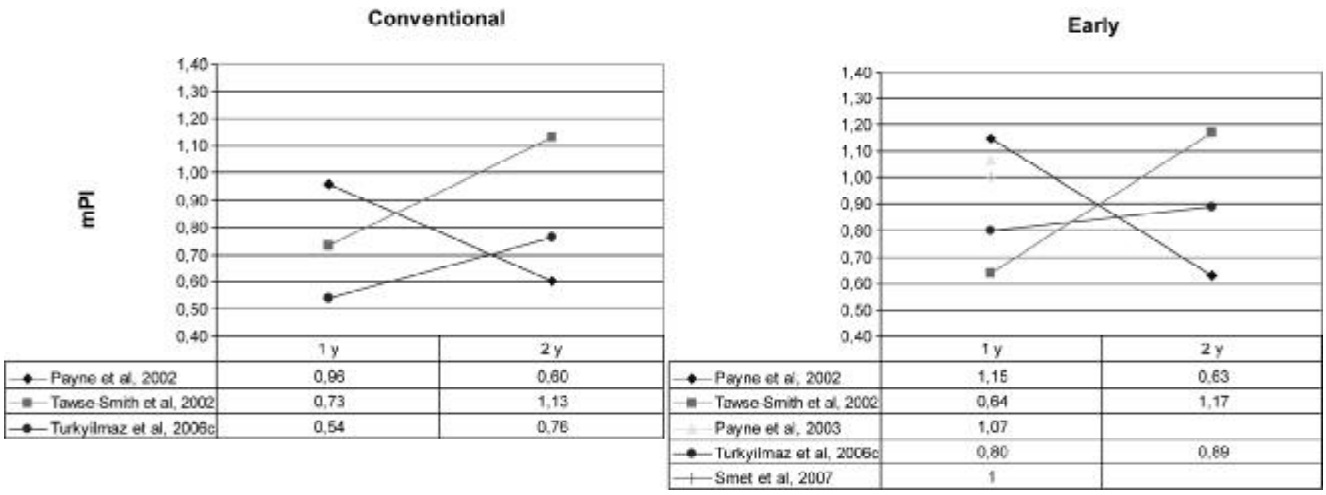

Fig. 3. Modified plaque index (mPI) values with conventional and early loading protocols at 1-year and 2-year follow-ups

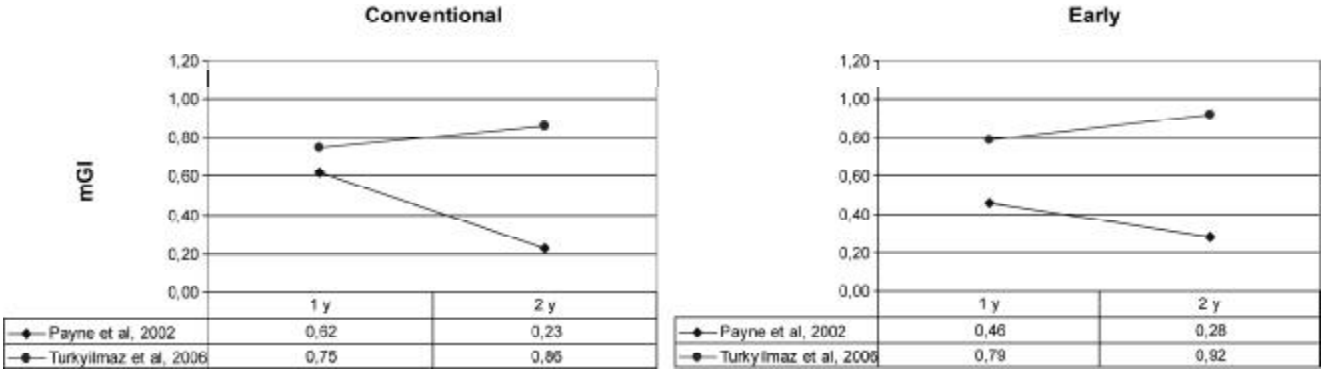

Fig. 4. Modified gingival index (mGI) values with conventional and early loading protocols at 1-year and 2-year follow-ups

both loading groups (conventional – 54%, early – 51%).

Prosthetic maintenance and patient satisfaction

The number of appointments and time needed for fabrication of overdenture in conventional and early loading groups was evaluated by Turkyilmaz et al [30]. Number of fabrication appointments was found to be significantly less in early loading group. Overdenture fabrication time was shorter (5.3 hours) in early rather than in conventional (6.8 hours) group. Twenty-four versus 17 adjustment appointments were needed in early loading and conventional groups respectively. Denture contouring was the most common type of adjustment. Number of overdenture repair incidences was slightly higher in early loading group. However, the differences between the groups regarding number of adjustments and repair appointments were not significant.

Similarly, only one study attempted to assess patient satisfaction [20]. However, no detailed data presentation regarding satisfaction scores in both loading groups were available. Patient satisfaction was registered by asking simple oral questions, and 3 categories of responses were recorded: very content, moderately content, and not satisfied. Satisfaction after 1 year was as follows: 13 patients were very content, 6 patients were moderately content, and 1 patient was not satisfied. Yet, no data were presented about satisfaction differences in both loading groups.

DISCUSSION

Due to a positive effect on patient satisfaction with two implant-supported mandibular overdentures, this approach is gaining wide acceptance, especially in the treatment of compromised patients of elderly age. Increased patient satisfaction, mastication performance and nutritional status are reported by multiple studies [31-33]. Despite wide use, there are no 100% guarantees that implant-supported mandibular overdentures would produce the undisputedly better outcomes (patient satisfaction, chewing efficiency, maintenance etc) in edentulous patients [34]. Not all factors are currently known, which potentially could determine the treatment results [35]. The future aim would be to precisely forecast treat-

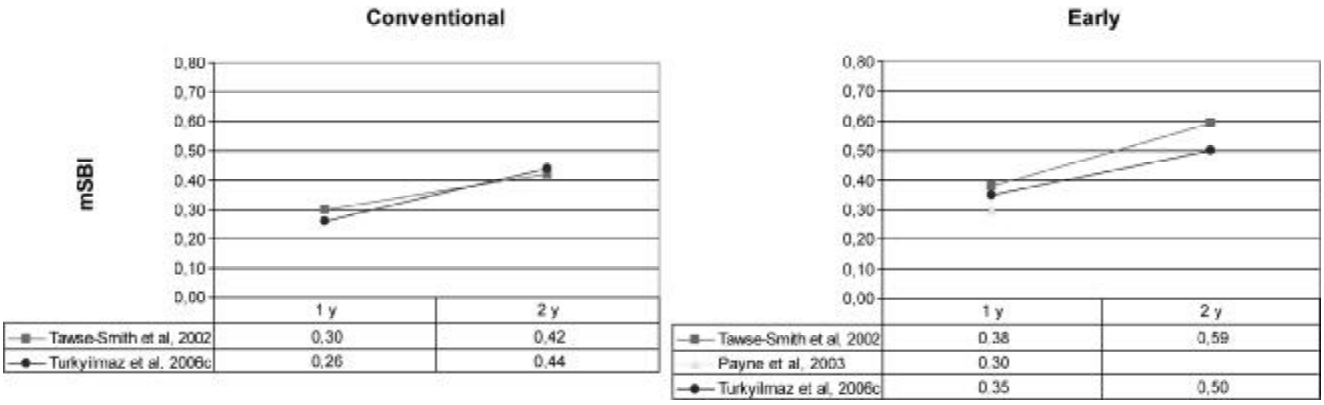

Fig. 5. Modified sulcus bleeding index (mSBI) values with conventional and early loading protocols at 1-year and 2-year follow-ups

ment outcome with mandibular overdentures before initiating the treatment [36].

In order to decrease treatment time, expenses and to increase patient satisfaction early and immediate loading protocols were proposed. Systematic review study evaluating different loading protocols included cases with 4 immediately loaded mandibular implants supporting overdentures [37]. It is widely recognized that immediate loading is possible when adequate primary stability is available, therefore splinting of immediately loaded implants is highly recommended. It could be assumed that overdentures supported by only 2 implants are loaded less favorably than supported by 4 implants. As loading conditions are different and limiting comparison between both groups, only 2 implant-supported mandibular overdentures were considered.

Immediate two-implant supported overdenture loading is not yet well documented. This review was able to detect only one study investigating effects of immediate loading of two-implant supported overdenture, which met inclusion/exclusion criteria but failed to pass quality assessment [38]. Therefore, it was decided to compare only early and conventional loading protocols, as immediate loading of two-implant supported overdentures currently is currently not well substantiated by research.

The aim of this review was to give the insight into implant supported mandibular overdenture treatment outcome with conventional and early loading protocols. Many studies have been done in order to investigate different loading strategies of implant supported mandibular overdenture. However, internal as well as external validity of them are often questionable. Short follow-up and lack of methodological quality, which leads to introduction of biases, are the issues leading to devaluation of studies. On the other hand, comparison of results is aggravated due to diversity in patient populations, medical products, surgical, prosthetic techniques, and methodologies used in different studies.

Comprehensive search resulted in identification of 221 primarily studies. After getting a number of primary research articles, it is necessary to decide the study selection criteria, which will be used to include or exclude studies. By selecting high "cut-off point" we can get a number of homogenous studies with high validity, however we can miss important information on the other hand. By means of highly sensitive approach, lower "cut-off point" in the selection process was used. After careful evaluation of allocation concealment, attempt to perform blind outcome assessment and reporting on drop-outs, only 8 studies were enrolled in further review process. The most common reasons of rejections were: more than 2 mandibular implants, fixed mandibular prosthesis, diabetic status, clinical trials without control group, too short follow-up period, probability of co-intervention and contamination, and cross-over of patients.

Majority of the studies investigating implant-supported mandibular overdentures report high implant survival and success rates with conventional loading protocol [39, 40]. However, it is possible to successfully employ early loading in selected patients. According to results of this review, implant survival rate was extremely high with conventional loading regimen, when results of one study [24] were excluded – 96-100%. High survival rates were reported with early loading as well 90-100%, except Tawse-Smith et al study where with Sterioss implants survival was very low – 71%. Among factors influencing survival and success of early loaded implants are: careful case selection, bone quality, implant dimensions and surface, proper treatment plan, meticulous surgery and proper design of prosthesis [41]. As deleterious effects of implant micromovements on osseointegration were revealed [42], a high degree of primary implant stability (high value of insertion torque) seems to be one of the prerequisites for a successful procedure [43]. Considering above-mentioned factors, selected studies were unequal. Study subjects differed in age, health status, habits, inclusion criteria were oriented towards different length of implants, quality of bone, primary implant stability etc. It is also acknowledged that not all clinicians may be able to achieve optimal results with early or immediate loading. Some of the studies have reported all early implant failures clustering in the group of shorter implants, or relating to particular operator [21]. Deliberating these factors, variations in implant survival and success rates can be explained. The lowest implant survival and success rates were associated with Sterioss implants used in study of Tawse-Smith et al. Conventionally loaded they had 88% success, while with early loading protocol – only 71%. The fact that these implants had turned surface could partially explain higher failure rates [44].

Mobility tests in early loading group revealed comparable stability to that of the conventional loading group [45]. The tendency of slight increase in

implant stability after 2 years as compared to 1-year follow-up could be noticed, thought there are concerns that progressing MBL can negatively affect stability measurements. Some studies, have detected statistically significant correlation between change of stability and marginal bone resorption from baseline to 6 months [30].

Peri-implant parameters provide valuable information on marginal bone status, soft tissue outcome and hygiene. Despite main peri-implant parameters, some of the studies have reported keratinized mucosa width changes and evaluated the influence of abutment height [23]. The MBL with different loading regimens were very similar at 1-year and 2-year follow-ups. Decrease in MBL in conventional group comprised 82% (from averagely 0.57 mm to 0.1 mm) and was comparable with early loading group – 83% (from averagely 0.53 mm to 0.09 mm). Considering many confounding factors, including different implant systems, surgical techniques etc., these discrepancies are surprisingly small. Selected studies reported no statistically significant differences on PD values between conventional and early loading groups, thought slight increase was characteristic for the early loading group. Due to implant coverage by the overdenture base, plaque control is of crucial importance. No significant differences in mPI were detected comparing loading protocols and follow-up periods. Few studies reported increased mPI values at the second year. Consequently, the same studies reported increased mSBI values at 2-year follow-up. This can be explained by oral hygiene instruction given at the baseline of the treatment. Patient motivation and strict recall program could be advantageous.

Despite comparatively big number of papers addressing implant supported overdentures, still there is no empirical evidence that the prosthodontic contribution of any particular attachment design is superior to the other. While some studies report lower burden of maintenance with bars than with balls [40, 46], due to diversity of attachment construction and complicated wear mechanisms it is virtually impossible to draw strict recommendations [10]. As different attachment systems could be a possible confounding factor [37], the fact that all selected studies employed ball attachments benefited review. However, only one study compared prosthetic maintenance between conventional and early loading groups. Detected higher number of prosthesis repair incidences in early loading group corroborated the findings of similar clinical trials [47].

Satisfaction with treatment is a highly complex phenomenon influenced by numerous factors, and not strictly related to the stomatognathic system. Yet, participant satisfaction is one of the highest goals in the treatment of edentulous individuals. Majority of studies report the dramatic and durable increase of patient satisfaction with mandibular overdentures. However, differences of satisfaction level between attachment systems often fail to be detected. There are concerns that satisfaction with ball-retained mandibular overdentures with time might decrease more than with bar-retained prosthesis [48]. Currently, there are no data to substantiate opinion that early loading is associated with higher patient satisfaction.

CONCLUSIONS

Considering the data of the selected studies, it can be concluded that:

1. Considering implant success rates early loading protocol with two implant-supported mandibular overdentures produces equal outcomes as with conventional loading;
2. Higher marginal bone loss (MBL) at 1-year follow-up compared with 2-year follow up was reported with both loading protocols. Conflicting results were obtained regarding some of peri-implant parameters (PD, mPI and mGI);
3. Shorter overdenture fabrication time and higher demand for adjustments could be expected with early loaded two implant-supported mandibular overdentures;
4. More well designed studies are needed to further substantiate the early loading protocol with two implant-supported mandibular overdentures and to provide rationale for clinical recommendations.

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