



Original article

Dental Implant Maintenance Experience: Testing Knowledge and Clinical Practices of Implant Clinicians in Libya

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ABSTRACT

Background: This study was aimed to survey clinicians in Libya for their routine approach of dental implant maintenance and to determine if a relationship exists between the formal undergraduate education and their previous attendance and interest in future implant related continuing education courses.

Methods: A survey of 35-questions specifically developed for this study was distributed to all implant clinicians attending a national continuing education course that was held in Tripoli on June/29/2018. All items on the survey reflected content found in publications that had addressed maintenance of dental implants. Participants voluntarily completed and submitted their questions survey to the corresponding author before the end of the course.

Results: Targeting 60 participants, the response rate was 63.33% (n=38). Four (10.5%) reported that they have practiced for over 15 years, while Nine (23.6%) have practiced 11 to 15 years. Fourteen (36.8%) have practiced 5 to 10 years and Eleven (28.9%) have practiced 5 years or less. Fourteen (36.8%) reported that they have not received training in class room and clinic on implant care while attending dental school. 5 (13.1%) have not participated in any continuing education course on implant maintenance after school graduation. The majority (94.7%) of the implant clinicians expressed interest in continuing education courses to strengthen backgrounds in maintenance of dental implants.

Conclusions: Results indicated that additional knowledge need to be gained regarding dental implant care in order to guide patients' confidence toward the optimal most successful teeth replacement option. Furthermore, a well-established structured academic program might be necessary to teach implant maintenance at undergraduate and postgraduate levels both theoretically and practically.

Keywords: Dental Implants, Implant Clinicians, Oral Examination, Instrumentation, Dental Continuing Education

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INTRODUCTION

Dental implants have become the most commonly chosen tooth replacement option among partially edentulous Libyan patients, and the frequency of placement has rapidly increased during the last two decades ¹. Consequently, clinicians who provide implant surgical and/or Prosthodontics treatment should develop and routinely provide patients' with a

dental implant oral hygiene maintenance protocol to ensure the longevity of the treatment provided. In addition, implant patients themselves should be advised that maintaining peri-implant tissue health is a key factor related to the long-term survival of dental implants².

The importance of maintaining good oral hygiene around dental implants was emphasized in an early consensus conference when the lack of adequate oral hygiene measures actually was considered as a possible contraindication to implant therapy³.

Dental implants oral hygiene protocol should include an initial assessment prior to surgery, immediately after surgery, and directly following completion of the prosthodontic phase of treatment. That protocol also should identify specific intervals for the long-term supportive (recall) appointments and include an effective patient-administered home care regimen to reduce the potential for implant loss through neglect⁴. Patient instruction in this protocol and the follow-up monitoring by office personnel must be elements central to an effective oral hygiene maintenance program.

Dental implant clinicians are routinely responsible for the continuity of patient education and maintenance of dental implants, years beyond initial placement. This care is referred to as the "first line" therapy or the nonsurgical approach⁵. However, there is a deficiency of evidence-based research regarding the best practices for implant maintenance, specifically by the implant clinicians. Graduates prior to the late 2000s may have had little to no formal education on implant care, yet they are treating patients with dental implants¹. Implant clinicians are encouraged to actively seek standardized and comprehensive training via professional-centred postgraduate education. Professional continuing education may similarly fulfil this need.

In this current study, Libyan dental implant clinicians from diverse educational and practice backgrounds will be surveyed in order to assess their routine approach for dental implant maintenance. This study also sought to determine if a relationship exists between the formal education and the previous attendance and interest in future continuing education courses about implants.

MATERIALS AND METHODS

After an extensive review of the literature, the authors developed a 35-item paper survey specifically for this study (Supplementary File). All items on the survey reflected content found in publications that addressed maintenance of dental im-

plants. Major part of our survey questions was based on that survey developed by RE based on Ward ST et al. (2012)⁶ article that discussed the routine approach of dental hygienists in the United States towards the maintenance of dental implants. The need for ethics approval was deemed unnecessary and only the authors considered the questions and content validity of the survey. In addition, the ethical national guidelines for biomedical research in Libya is still under processing and organization.⁷

The questionnaire was distributed to all attendees of the national continuing education course that was held in Tripoli on June 29, 2018 (n=60). Participants were conveniently sampled and volunteered to submit their survey before the end of the course day. Surveys submitted after the day of the course were not included in this study. Completed surveys were returned to the continuing education staff members before the data collection deadline. Data were entered in a spreadsheet by RE and then independently verified by YE to ensure its accuracy.

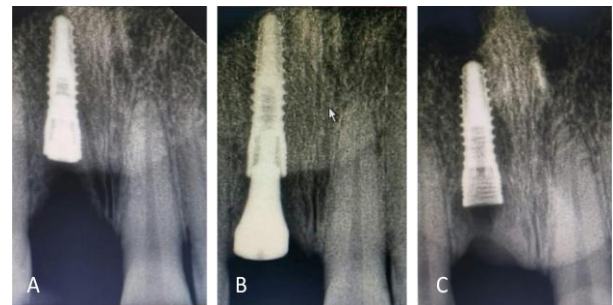


Figure 1:
A: Implant replacing tooth # 8 (US) after complete osseointegration.
B: Soft tissue former misfit due to using different system healing abutment.
C: Lost healing abutment lead to peri-implantitis.

RESULTS

The response rate was 63.3% (n=38). Four (10.5%) contributors reported practicing for over 15 years, while Nine (23.6%) have practiced for 11 to 15 years. Fourteen (36.8%) have practiced 5 to 10 years and Eleven (28.9%) have practiced 5 years or less.

Fourteen (36.8%) contributors reported that they have not received training in class room or clinic on implant care while attending dental school. Five (13.1%) have not participated in any continuing education course on implant maintenance after school graduation.

Chi-square test was used to determine if there is a relationship between the type of undergraduate education (formal education versus no formal education) and post-graduate continuing education course attendance (attended course versus did not attend course). The results indicate that there is no statistically significant association between the type of undergraduate education and post-graduate continuing education course attendance ($\chi^2=1.21$, $df=1$, $p=0.25$). There was no statistically significant difference in continuing education interest between clinicians whose formal education did or did not include dental implants. The majority (94.7%) of the implant clinicians expressed interest in continuing education courses to strengthen backgrounds in maintenance of dental implants.

A summary of the survey responses regarding procedures for dental implant maintenance is shown in Tables 1 through 6. (Table 1) summarizes responses regarding the maintenance intervals for dental implants after implant placement. Over 60% ($n=23$) of participants reported that they usually schedule implant patients for maintenance during the first 3 months after implant placement, whereas 10.5% use to evaluate their implant patients during the first week after implant placement, and only 5 (13.1%) use to see their patients every two weeks after implant placement.

(Table 2) summarizes the responses regarding maintenance intervals for dental implants after the delivery of the prosthesis. About 65% ($n=25$) schedule their implant patients for follow up after prosthesis delivery and 21% ($n=8$) schedule implant patients only on individualized need for maintenance after prosthesis delivery.

(Table 3) summarizes the responses regarding

clinical assessment of dental implants. Over 89% ($n=34$ to 38) of participants use to evaluate plaque/calculus deposits, exudate/bleeding, mobility and inflammation in their patients. Fewer than this ($n=7$, 44.7%), evaluate the presence of salivary percolation around the margin of crowns covering implants when slight finger pressure is applied. The majority of respondents probe around dental implants ($n=34$, 89.5%) and use a metal probe ($n=27$, 71.1%) while only ($n=7$, 18.4%) use a plastic probes. Over half ($n=26$, 68.4%) record the presence of bleeding on probing and the majority consider evaluating occlusion and recession around implants.

(Table 4) summarizes responses regarding the radiological assessment of dental implants. Only 6 respondents (15.7%) used to take radiographs of dental implants at least once per year; 15.7% ($n=6$) reported taking Periapical views as the most common type of radiographs taken, while 29% ($n=11$) are routinely taking panoramic radiographs of implants. Eleven participants do not check bone level surrounding the implant on a regular basis at maintenance appointments.

In (Table 5), the implant clinicians most commonly reported that they perform supra-gingival instrumentation around dental implants ($n=20$; 52.6%) whereas only 13 (34.2%) perform subgingival instrumentation. Only ($n=7$; 18.4%) use Stainless steel scalers during debridement, while a few ($n=4$, 10.5%) use plastic scalers on dental implants.

As shown in (Table 6), nine participants (23.6%) indicated that they use medium prophylaxis paste for coronal polishing of implant restorations, only 4 (10.5%) use toothpaste for polishing, and 12 (31.5%) reported polishing the implant post if visible.

Table 1: patients' responses regarding the maintenance intervals for dental implants after implant placement

Criteria	n =	%
Schedule implant patients for maintenance during 1 st three months after implant placement	23	60.5%
Schedule implant patients for maintenance during 1 st week after implant placement	4.0	10.5%
Schedule implant patients for maintenance every 2 weeks after implant placement	5.0	13.1%
Schedule implant patients for maintenance every month after implant placement	11	28.9%

Table 2: responses regarding the maintenance intervals for dental implants after the delivery of the prosthesis

Criteria	n =	%
Schedule implant patients after prosthesis delivery	25	65.8%
Schedule implant patients every 3 months for maintenance after prosthesis delivery	5.0	13.1%
Schedule implant patients every 6 months for maintenance after prosthesis delivery	10	26.3%
Schedule implant patients annually for maintenance after prosthesis delivery	4.0	10.5%
Schedule implant patients only on individual need for maintenance after prosthesis delivery	8.0	21.0%

Table 3: responses regarding the clinical assessment of dental implants

Criteria	n =	%
Evaluate amount of adjacent keratinized tissue	31	81.5%
Evaluate color of adjacent gingival tissue (inflammation present)	38	100%
Evaluate presence of stippling/tissue consistency	23	60.5%
Evaluate presence of exudate/bleeding	34	89.4%
Evaluate presence of deposits (plaque and/or calculus)	37	97.3%
Evaluate presence of salivary percolation when slight pressure is applied to the crown of an implant	17	44.7%
Evaluate mobility	36	94.7%
Evaluate occlusion	37	97.3%
Evaluate parafunctional habits (grinding, abrasion)	34	89.5%
Evaluate recession	38	100%
Probe around implants	34	89.5%
Use plastic probe	7	18.4%
Use metal probe	27	71.1%
Record the presence of bleeding on probing around the implant	26	68.4%

Table 4: responses regarding the radiological assessment of dental implants

Criteria	n =	%
Routinely takes periapical radiographs of implants	6	15.7%
Routinely takes bitewing radiographs of implants	5	13.1%
Routinely takes panoramic radiographs of implants	11	28.9%
Does not routinely take radiographs of implants	8	21%
Checks bone level surrounding the implant on a regular basis at maintenance appointments	22	57.9%
Does not check bone level surrounding the implant on a regular basis at maintenance appointments	11	28.9%
Takes radiographs of an implant once a year	6	15.7%
Takes radiographs of an implant every 6 months	2	5.2%
Takes radiographs of an implant every 3 months during the 1st year and every 6 months thereafter	6	15.7%
Takes radiographs of an implant every 3 months during the 1st year and annually thereafter	2	5.2%
Takes radiographs of an implant at a different established interval	4	10.5%
Takes radiographs of an implant at no set interval	11	28.9%

Table 5: responses regarding Scaling Instruments

Criteria	n =	%
Performs supragingival instrumentation around implants	20	52.6%
Performs subgingival instrumentation around implants	13	34.2%
Uses Ultrasonic scalers during debridement around implants	8	21.0%
Uses Stainless steel scalers during debridement around implants	7	18.4%
Uses Plastic scalers during debridement around implants	4	10.5%
Uses Graphite scalers during debridement around implants	2	5.2%
Uses Teflon-coated scalers during debridement around implants	2	5.20%
Uses plastic Gold-tipped during debridement around implants	1	2.60%

Table 6: responses regarding Coronal Polishing

Criteria	n =	%
Uses fine prophy paste for polishing the implant/crown	4	10.5%
Uses medium prophy paste for polishing the implant/crown	9	23.6%
Uses tin oxide for polishing the implant/crown	Nil	Nil
Uses air polisher for polishing the implant/crown	Nil	Nil
Uses toothpaste for polishing the implant/crown	4	10.5%
Uses implants' prophy paste for polishing the implant/crown	Nil	Nil
Polishes the implant post if it is visible	12	31.5%

DISCUSSION

The long time gone since graduation may explain why almost half of the participants in this study did not receive formal training on dental implant maintenance. Dental implants may not have been part of their curriculum at undergraduate levels.

Humphrey noted that dental implants have become an integral part of dental reconstruction and quotes that approximately half a million dental implants are placed annually in the United States of America⁸. Although there are no available data estimating the exact number of dental implants integrated each year in Libya, it was reported that half of the partially edentulous Libyan patients opted for dental implants when a definitive tooth replacement modality was considered¹. Accordingly, it is necessary that implant clinicians have the most current knowledge for the maintenance of dental implants.

One of the earlier articles to discuss implant oral hygiene maintenance appeared in 1990 and emphasized the importance of patient oral care throughout the continuum of pre-surgical, surgical, and restorative/maintenance phases of treatment⁹. The authors emphasized that a thorough periodontal assessment should be performed prior to implant surgery. In addition, patients must be trained in an appropriate oral homecare program before the implants are placed, and then placed in a maintenance regimen at appropriate intervals after implant placement.

The rationale for this emphasis on proper oral care is a simple one. During the healing phase, for example, it is essential to prevent the development of an inflammatory response around both the natural teeth and any implant surgical site. An inflammatory process will interrupt the normal healing process and jeopardize osseointegration of the implants. At the first follow-up, during the first week following surgery, a plastic curette can be used to gently debride the adjacent teeth of plaque and *Materia Alba* to maintain a healthy biological environment.

When sutures are needed to secure soft tissue, additional instructions may need to be given to the patient, because sutures can make it more difficult to maintain oral hygiene. It may be very helpful to advise patients not to use a dental brush to clean the implant site. Instead, a Q-tip soaked in the chlorhexidine gluconate solution, can be used gently to wipe across the surgical area in a facio-lingual direction. It is advisable to record the number and type of sutures placed to ensure all suturing materials are removed at the appropriate post-operative appointment which usually takes place at the second follow-up ten days

to two weeks after surgery.

In case of a single stage procedure, where healing abutments (Soft tissue formers) are projecting through the mucosa, the follow up visit should include evaluating the color and consistency of soft tissue around. Special instructions may be necessary when there is a limited mesio-distal space and the healing abutment is therefore located close to a natural tooth. This proximity may restrict access for hygiene procedures due to limited space between the abutment and adjacent tooth/teeth.

If a temporary restoration was immediately connected to the implant (Immediate Temporization), care should be taken if a motorized tooth brush is routinely used not to apply too much mechanical motion on crown. It may be wise to use manual gentle brushing and flossing instead. It is usually helpful at the 1 week follow up visit to verify tightness of the temporary abutment screw and that neither occlusal nor proximal contacts are encountered.

In this study, only 10.5 % (n=4) of clinicians schedule their patient for follow up during the first week of implant placement. It may be prudent to see patients of dental implant one week to 10 days after surgical integration to confirm proper hygiene measures and to maintain healthy peri-implant mucosa.

This study revealed that only 11 participants (28.9%) schedule implant patients for maintenance every month after implant placement. The main purpose of this appointment is to ensure oral hygiene procedures are being effectively implemented. If adjustments or oral hygiene reinforcement are required at this pre-prosthetic appointment, then it is prudent to schedule another 1-2 week visit before loading the implant with a definitive coronal restoration.

Following treatment completion, the patient should be seen several times during the first year since there are no guidelines regarding the time intervals of care that optimize peri-implant health¹⁰.

This study has shown that only 25 (65.8%) of surveyed participants schedule their patient for implant maintenance after prosthesis delivery. However, patients should be seen during the first 1-2 weeks after crown placement. The main purpose of this appointment is to ensure oral hygiene procedures are being effectively implemented. This appointment also serves another purpose. It allows the restorative dentist to decide if desired occlusal relationships were attained or if additional modifications are necessary. While in the office, the patient should be encouraged to ask any questions that may

have risen since the last visit and especially now that treatment is complete. This early post-prosthetic appointment is particularly important when crowns are cemented over abutments as invisible cement residues can serve as a documented cause of peri-implant disease,¹¹ this includes fistulas/fenestrations as well as bone loss and consequent implant loss.

Once the results of the initial post-prosthetic appointments were reasonable, the patient need only to be arranged for a 3-month follow-up dental hygiene appointment. This timing seems applicable because it has been shown that plaque-induced peri-implant mucositis can develop in a 21-day period, if no oral hygiene procedures are accomplished¹².

Therefore, if the patient's oral hygiene practices truly are inadequate during this first 3-month period, those signs will be detected early and corrective measures can be employed in a timely manner. Furthermore, a decision can be made as to the need for continuing a 3-month recall schedule or whether 6-month recall intervals can be used. If there is any doubt about the patient's maintenance practices, a 3-month recall schedule should be maintained. Our study revealed that only 10 (26.3%) of questioned clinicians schedule their patients for follow ups after 6 months of prosthesis delivery. Despite the evidence-based data reporting that most implant losses occur during the first year of function,¹³ only half of the participants schedule their implant patients for follow ups during this time interval.

Regarding the items to be evaluated at each recall appointment, a previous clinical review¹⁴ has proposed that each periodic examination should include an assessment of medical and dental histories, soft tissue assessment, plaque score using either of the two implant-specific plaque indices¹⁴, pocket depth, bleeding on probing, presence of suppuration, stability of soft tissue margins, presence of keratinized tissue, occlusion, mobility, and checking radiographs. This study has shown that 31 (81.5%) evaluate amount of keratinized tissue around dental implants. Minimal keratinized mucosa around implants may show increased mucosal recession, greater plaque accumulation, peri-implant mucositis, and increased bone loss.^{15, 16} However, no relationship was found between keratinized tissue widths and implant survival in two literature reviews^{17, 18}.

When keratinized mucosa is lacking around implants, the indications for the use of soft-tissue grafting are unclear¹⁹. Therefore, it has been stated that preventive surgery should be confined to situations where altered morphology of the peri-implant mucosa affects oral hygiene²⁰.

All of the participants (100%) reported that they

evaluate recession around dental implants. Causes of recession may include overzealous brushing, absence of attached mucosa, high frenal attachment, and too buccally placed immediate implants²¹.

Probing around implants should be considered a reliable and sensitive parameter for the long term monitoring of peri-implant mucosal tissues²².

Disposable plastic probes and replaceable plastic probe tips that screw into autoclavable metal handles have been recommended over metal probes that are being used by more than 70% of Libyan implant clinicians according to this survey²³.

Probing depths typically are deeper at implant sites than they are at natural tooth sites. In one report, the average probing depths around healthy implants ranged from 1.3 - 3.8 mm²⁴.

A postoperative radiograph after implant placement is not pertinent with over 20% of the participants. In fact, postsurgical radiographs can serve multiple functions including base line for checking bone level around the implant at maintenance appointments, confirmation of implant positions and angulations, and verification of complete seating of cover screws, healing abutments, or coronal restorations if immediately loaded (Figure 1).

Periapical radiographs provide excellent information about the bone levels, particularly when paralleling devices are used. This study results showed that almost 29% (N=11) of clinicians do not check bone level surrounding the implant on a regular basis at maintenance appointments.

Some reduction in marginal bone height will usually be noted on a radiograph during the first year following implant placement with 0.9 mm being typical¹³. However there should be very little, if any, clinically perceptible change after that time.

Regarding scaling instruments, researches indicate that stainless steel metal hand scalers can damage titanium surfaces^{25, 26} and, therefore, they are not recommended. In contrast, plastic scalers have proven to be safe and do not damage titanium components.²⁷

An apparent paradoxical finding was reported in one study of plastic scalers where there was an increase in the recorded surface roughness due to deposits of plastic particles and debris on the surface of titanium abutments that altered the surface roughness readings²⁸.

While plastic scalers are kind to titanium surfaces, some clinicians find them to be somewhat bulky or too flexible to use in the removal of hard deposits. Unlike metal scalers, plastic tips lack sharpness which is believed to limit their effectiveness in dislodging larger, hard deposits.

Circumventing these limitations of plastic scalers has been achieved in different ways. When larger accumulations of hard deposits are present, some clinicians carefully use metal scalers initially. It is only after removal of the bulk deposits that they switch to plastic scalers for the final surface scaling. Others feel conventional metal scalers can be used to remove calculus and only leads to minor surface scratching of supra-mucosal surfaces when used carefully. However, there is no scientific evidence to support these concepts. These are considered empirical finding but, nonetheless, recommendations based on years of clinical experience. Some clinicians have also reported wrapping a metal scaler with gauze to remove calculus and in so doing reduce the risks of scratching or gouging of the implant surface.

Fiber reinforced graphite scalers (Premier® Implant Scaler; Premier Products Co., 1710 Romano Drive, Plymouth Meeting, PA 19462 ; www.premusa.com) have been found to produce significantly less roughness compared to stainless steel scalers, and they are deemed to be appropriate instruments to use for scaling procedures ²⁹.

It has been shown that titanium hand scaling instruments removed very little substance from the head of implants and from titanium abutments, leaving “virtually no traces of use” ³⁰. Nonetheless, it seems prudent to use care with any hand instrument made of material harder than plastic to remove deposits around single implants. Light pressure strokes should be applied along with careful adaptation of the instrument to the cervical contours of the crown. When used in accordance with these guidelines, titanium tipped curettes can remove adherent plaque and calculus deposits effectively without damaging the implant metal surfaces or causing excess soft tissue trauma.

Negative surface changes (scratches, depressions, removal of surface metal) have been found from using metal ultrasonic scaler tips on titanium, ³¹ whereas ultrasonic scalers with plastic tips ^{32, 33} and carbon tips ^{31, 33} produced no significant surface alteration to titanium surfaces. Therefore, when ultrasonic scalers are used, metal tips should be avoided.

It has been proposed ³⁴ that a soft rubber tip, not brush, be used around implants in conjunction with an appropriate nonabrasive paste such as aluminum oxide, tin oxide, acidulated phosphate fluoride-free prophylactic paste, or low-abrasive dentifrice. According to one report, the use of a rubber cup with toothpaste did not affect the integrity of a highly polished titanium surface ²⁶.

In another study, when a rubber cup and flour of pumice were applied to a machined titanium surface for five minutes, the microscopic grooves from the titanium machining process were removed, but the surface still was judged to be smooth ³⁵.

Others found the use of a rubber cup and a fine abrasive paste to be a safe procedure for supragingival surfaces ³⁶. However, using a rubber cup with a coarse prophylactic paste for 30 seconds removed approximately one-half of a 0.11 mm high ridge of titanium on test samples ²⁶.

The use of acidulated fluoride gels should be avoided around dental implants since it has been determined they produce surface degradation of titanium ^{37, 38}. For this reason, neutral pH fluoride gels should be used when caries prevention is needed in the mouths of patients with dental implants.

Conclusion: This study provided a descriptive summary of knowledge-seeking practices and clinical approaches used by dental implant clinicians in the maintenance of dental implants.

Results indicated that additional knowledge need to be gained regarding dental implant care in order to guide patients' confidence toward the optimal most successful teeth replacement option. Furthermore, a well-established structured academic program might be necessary to teach implant maintenance at undergraduate and postgraduate levels.

List of Abbreviations: Not applicable.

Declarations: Ethical Approval and Consent to participate: Not applicable. The need for ethics approval was deemed unnecessary and only the authors considered the questions and content validity of the survey. In addition, there are no clear ethical national guidelines for biomedical research in Libya. Furthermore, Libyan law on research policy, which adds another dimension to this sensitive and vital issue, does not require ethical approval to be attained prior to commencing a research project ⁷.

Consent for Participation: an informed verbal consent was obtained from all participants and participants were conveniently sampled and volunteered to submit their surveys. Libyan law on research policy does not require ethical written consent to be attained prior to participating in a research project.

Consent for Publication: I give my consent for my research study article titled Dental Implant Maintenance Experience: Testing Knowledge and Clinical Practices of Implant Clinicians in Libya to be published in Libyan Journal of Dentistry.

Availability of data and materials: The datasets used

and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing Interests: Not applicable.

Funding: This study was not funded by any organization or institute. No financial support was received at any step of the study conduction.

Authors' Contributions: the corresponding author RE developed a 35-item paper survey specifically for this study. All items on the survey reflected content found in publications that addressed maintenance of dental implants. Both Authors considered the questions and content validity of the survey .

Data were entered in a spreadsheet by RE and then independently verified by YE to ensure accuracy.

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