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Clinical follow-up evaluation of Dalbo[®]–Rotex[®] retention elements in the private practice

KEYWORDS

Retention element
Dalbo[®]–Rotex[®]
Removable denture
Efficacy
Private practice
Patient satisfaction

SUMMARY

The aim of this retrospective study was to investigate the clinical outcome of Dalbo[®]–Rotex[®] retention elements in a private practice. The majority of the retention elements was fixed with self-adhesive composite cement, and in almost 40% the exposed root surface was additionally covered with composite. The success rate of 96.3% after 24 months in a total of 50 included patients (response rate 48.5%) demonstrated that a simple and cost-effective fixation of removable dentures using prefabricated, chair-side inserted retention elements is feasible. Maintenance care comprised single or repeated replacement and activation of the female part in 12.3% and 39.4% of the cases, respectively.

Fractures were rare, occurring in 3.4% of the cases and more likely in patients with parafunctional habits. Frequent oral hygiene correlated with probing depths up to 3 mm at the maximum, while the risk of greater probing depths associated with less frequent oral hygiene increased by a factor of 2.4. Patients' assessment of the parameters handling and wearing comfort, chewing ability and prosthesis retention was predominantly positive. Based on the findings of the study, covering of exposed dentin areas with composite resin and regular recall comprising professional cleaning, fluoride application and oral hygiene instruction are recommended.

Introduction

According to the data from the last Swiss health survey of 2012 an increasing proportion of patients keeps a major number of own teeth up to an advanced age (SCHNEIDER ET AL. 2017). Despite of this, removable dental prostheses become necessary in many cases, which are retained by various visible or hidden retention elements (REs). In the case of root canal-treated teeth and substantial loss of coronal hard tissues, root post copings (RPCs) are indicated, which are anchored in the root canal by a post, cover the exposed part of the root, and enable to fix a prefabricated RE on the covering plate. Such an indirect fabrication of RPCs by the dental technician allows to select an insertion direction common to all REs. The fixation of removable dental prostheses with RPCs comprises several treatment steps and is thereby time-consuming and cost-intensive. As a simple and cost-effective alternative, prefabricated root screws with a ball attachment in the form of Dalbo®-Rotex® REs can be applied chair-side by the dentist. The well-established ball according to Dalla Bona with a diameter of 2.25 mm with various systems of female parts is used. Even if the prognosis of the tooth root is uncertain, these REs allow achieving an adequate solution for the anchorage of partial or complete dentures (DALLA BONA 1981; BRUNNER 1983, 1986, 1987; TEUBNER & MARI-NELLO 2005).

In the case of indirectly manufactured RPCs, success rates of 85% after seven years were found (MERICSKE & MERICSKE-STERN 1993). Complications and failures were primarily related to carious lesions, vertical root fractures, loss of retention, or endodontic pathologies (DALLA BONA 1987; MERICSKE 1994; YU ET AL. 2012). Concerning comfort and retention a high patient satisfaction of $\geq 70\%$ on visual analogue scales (VAS) was reported following treatments using REs and removable dental prostheses (HUG & MERICSKE-STERN 2006). Regarding the Dalbo®-Rotex® system no long-term data besides documentations from university clinics are available, and an evaluation in the private practice for determining the effectiveness is indicated.

The aim of the present retrospective clinical investigation was to assess the patient satisfaction and success rate related to treatments of roots using the Dalbo®-Rotex® system.

Materials and Methods

Based on the electronic recording of the Swiss dental tariff position 4,592 (intracanal root screw), 103 patients of a private practice (Dres. med. dent. S. and E. Teubner, Langenthal, Switzerland) could be identified, in whom at least one Dalbo®-Rotex® RE had been inserted in the period from April 2009 to April 2015. Inclusion criteria were an observation period of at least six months and the written consent of the patients. The protocol of this retrospective study was approved by the ethics committee Bern (KEK-BE 203/2014). Relevant data regarding type and size of the RE, the technique of insertion as well as complications or losses during the observation period were taken from the patient records (Tab. I). In the context of the clinical follow-up evaluation in the period from August 2015 to January 2016 it was first checked whether the RE was stable *in situ*; subsequently periodontal, endodontic, and reconstructive findings were collected (Tab. IIa). For the determination of the success rates of the REs both losses (extractions of the abutment teeth) and complications associated with the RE were analyzed (Tab. IIb). Caries of the abutment teeth was assessed separately, because this does not have to directly affect the RE. For the assessment of the periapical conditions, a single-tooth

radiograph was made, in which the length of the residual sealing in the root canal as well as the presence of an apical radiolucency were recorded. The patients completed a written questionnaire for the evaluation of the oral and denture hygiene, the wearing habits, and the satisfaction (on a VAS from 0% to 100%).¹ No costs for the examination and assessment were incurred by the patients.

Statistical methods

The descriptive analysis of the recorded parameters was made using means and standard deviations or percentage distributions. In order to investigate potential correlations between two variables, contingency tables were created and Fisher's exact test or the chi-square test applied. For determining the Kaplan-Meier success rates, REs which were complication-free *in situ* were rated as "success" and contrasted with REs which manifested complications or had been lost. In addition, correlations between success and clinical parameters were investigated by means of a logistic regression model yielding odds ratios (OR) with 95% confidence intervals (CI) and the respective p-values. The level of significance was set at $\alpha = 0.05$.

Results

At the time of data recording, six of the 103 patients identified had already died. Altogether 50 patients (23 females and 27 males) with 119 inserted REs could be included in the analysis. This corresponds to a participation rate of 48.5% of patients, in whom 66.5% of the initially inserted REs were assessed. The average age of the included patients was around 69.9 years (± 10.2 years), and the average observation time amounted to 29.8 months (± 14.9 months; Tab. I).

Among the 119 REs evaluated, 42 (35.3%) were located in the maxilla and 77 (64.7%) in the mandible. In about half of the cases each, REs with a quadratic basis according to Dr. Dalla Bona and with a round basis according to Prof. Brunner were utilized (Tab. I). The majority (114) of the REs was inserted with self-adhesive composite cement (RelyX™ Unicem, 3M ESPE, Rueschlikon, Switzerland), and in almost 40% the exposed root surface was additionally covered with composite filling material (Fig. 1a, b). As far as the female parts were concerned, the systems Dalbo®-Classic (43.7%) and Dalbo® PLUS (36.1%) were applied most frequently, while the Galak® female part intended for temporary fixation was used more rarely (17.3%). In 7 (5.9%) REs no female part was inserted, because in the patients' judgment the denture retention was already sufficient or too strong. In most cases (70.6%), the removable restoration was designed with an open access to the REs (i.e. denture base not extended to the vestibule). In somewhat more than half of the REs (54.6%) a removable partial denture, and in 14 (11.8%) a full denture had been incorporated in the opposite jaw; in the case of 40 REs (33.6%) antagonists were the natural dentition. In almost all instances (105 REs, 88.2%) a new manufacturing of the reconstructive restoration was the main reason for the insertion of the Dalbo®-Rotex® RE, while 14 REs (11.8%) were made in connection with an extension of the existing dental prosthesis. The cost factor mostly (117 REs, 98.3%) was decisive for the selection of the RE mentioned, although reduced general health of the patient associated with the request for rapid insertion con-

¹ The questionnaires concerning oral and denture hygiene as well as patient satisfaction can be obtained from the authors.

stituted an additional indication criterion in the case of 68 REs (57.1%; Tab. I).

At the time of the clinical examination, 114 (95.8%) REs were still *in situ*, while in the course of the observation period five teeth supporting REs in five patients had to be extracted. Based on the patients' charts these extractions were attributed to fractures of the RE (once Dalla-Bona after 9 months, once

Brunner after 33 months), progression of the periodontal disease (twice, after 33 and 42 months), and one extraction was in connection with a new prosthetic treatment (after 9 months). Moreover, four additional complications were identified based on a review of the records: loss of retention and re-cementing in two REs (after 37 and 47 months), and in the case of two roots afflicted by fractures of the RE (Dalbo®-Rotex® size 1)

Tab. I Distribution of the Dalbo®-Rotex® retention elements included (n=119)

Parameter		n (%)	Mean (SD)
Number of retention elements		119 (100)	
Patients included and re-examined	females	23 (46)	
	males	27 (54)	
Age at follow-up evaluation in years			69.9 (10.2)
Observation time in months			29.8 (14.9)
Type of tooth	single-rooted	107 (89)	
	multi-rooted	12 (11)	
Localization	mandible	42 (35.3)	
	maxilla	77 (64.7)	
Type of Dalbo®-Rotex® root anchor	Dalla Bona size 1	49 (41.2)	
	Dalla Bona size 2	14 (11.8)	
	Brunner size 1	16 (13.4)	
	Brunner size 2	40 (33.6)	
Covering of the exposed dentin surface	no	72 (60.5)	
	yes	47 (39.5)	
Cement	RelyX™Unicem	114 (95.8)	
	Multilink® Automix	5 (4.2)	
Female part used	Dalbo®PLUS	52 (43.7)	
	Dalbo®-Classic	43 (36.1)	
	Galak®	17 (14.3)	
	none	7 (5.9)	
Denture with framework	no	99 (83.2)	
	yes	20 (16.8)	
Denture design in periodontal region	concealed	35 (29.4)	
	accessible	84 (70.6)	
Number of additional clasps included in RDP			1.2 (1.3)
Number of additional copings included in RDP			1.9 (1.6)
Number of implants included in RDP			0.1 (0.3)
Antagonistic situation	RDP	65 (54.6)	
	complete denture	14 (11.8)	
	natural dentition	40 (33.6)	
Prosthetic starting situation	new treatment	105 (88.2)	
	extension	14 (11.8)	
Selection of Dalbo®-Rotex®: - as temporary solution	no	110 (92.4)	
	yes	9 (7.6)	
- for cost reduction	no	2 (1.7)	
	yes	117 (98.3)	
- as simple and rapid solution in the context of a reduced GHC	no	68 (57.1)	
	yes	51 (42.9)	

RDP = removable dental prosthesis, GHC = general health condition, SD = standard deviation

after 19 months, a new RE (size 2) could be inserted (Tab. IIb). Thus, the success rate after 24 months amounted to 96.3% (95% CI: 92.8%, 99.9% with n = 102) and after 60 months to 78.7% (95% CI: 63.3%, 98.0% with n = 11; Fig. 2).

The clinical examination of 114 REs revealed that the probing depths around 95 REs (83.3%) were 3 mm at the maximum. Bleeding on probing (BoP+) was recorded in 78 REs (68.7%); periapical radiolucencies and carious lesions were diagnosed in 9 REs (7.9%) and 18 REs (15.8%), respectively. In this connection clustering became apparent in five patients who exhibited

two and three carious REs. Six of the 18 carious lesions occurred in roots covered with composite resin. A single or repeated activation of the female parts was necessary in 45 REs (39.5%). In the case of 14 REs (12.3%) the female part had to be replaced once (9) or several times (5). In 18 REs (15.9%) lateral wear of the ball was evident (Tab. IIa).

The evaluation of the questionnaires revealed that patients predominantly cleaned their teeth twice (41.2%) or three times (23.7%) a day, while one daily cleaning and one cleaning every few days was indicated by 32.5% and 2.6%, respectively. Den-

Tab. IIa Results of the clinical follow-up evaluation (n = 114)

Parameter	Criteria	Females (%)	Males (%)	n (%)
Probing depths (maximum value per tooth)	1–3 mm	44 (89.8)	51 (78.5)	95 (83.3)
	4–5 mm	4 (8.2)	11 (16.9)	15 (13.2)
	>6 mm	1 (2)	3 (4.6)	4 (3.5)
Bleeding on probing (BoP+)	no	20 (40.8)	16 (24.6)	36 (31.6)
	yes	29 (59.2)	49 (75.4)	78 (68.4)
Plaque	no	36 (73.5)	31 (47.7)	67 (58.8)
	yes	13 (26.5)	34 (52.3)	47 (41.2)
Denture hygiene	no	6 (12.2)	3 (4.6)	9 (7.9)
	yes	43 (87.8)	62 (95.4)	105 (92.1)
RCF on X-ray	>2 mm residual sealing present	49 (100.0)	65 (100.0)	114 (100)
Apical radiolucency	no	46 (94)	59 (90.8)	105 (92.1)
	yes	3 (6)	6 (9.2)	9 (7.9)
Caries	no	41 (83.7)	55 (84.6)	96 (84.2)
	yes	8 (16.3)	10 (15.4)	18 (15.8)
	– with CC			6 (13)
	– without CC			12 (17)
Caries extension	<33%	41 (83.7)	55 (84.6)	96 (84.2)
	<66%	7 (14.3)	8 (12.3)	15 (13.2)
	100%	1 (2)	2 (3.1)	3 (2.6)
Frequency of activation of female part	never	28 (57.2)	41 (63.1)	69 (60.5)
	1x	11 (22.5)	9 (13.8)	20 (17.5)
	2x	1 (2.0)	13 (20.0)	14 (12.3)
	3x	8 (16.3)	0 (0)	8 (7.1)
	>4x	1 (2.0)	2 (3.1)	3 (2.6)
Frequency of replacement	never	46 (93.9)	54 (83.1)	100 (87.7)
	1x	1 (2.0)	8 (12.3)	9 (7.9)
	several times	2 (4.1)	3 (4.6)	5 (4.4)
Wear on lateral aspect of RE visible	no	44 (89.8)	52 (80)	96 (84.2)
	yes	5 (10.2)	13 (20)	18 (15.8)

RCF = root canal filling, CC = composite covering, RE = retention element

Tab. IIb Frequency of losses and complications of the Dalbo®-Rotex® retention elements (n = 119)

Causes of complications and losses of retention elements	Females (%)	Males (%)	n (%)
Root fracture	0 (0)	1 (1.5)	1 (0.8)
Periodontal disease progression	1 (2)	1 (1.5)	2 (1.7)
Endodontic failure	0 (0)	0 (0)	0 (0)
Fracture of the retention element	1 (2)	3 (4.4)	4 (3.4)
Extraction due to new treatment	1 (2)	0 (0)	1 (0.8)
Loss of retention	0 (0)	1 (1.5)	1 (0.8)
<i>In situ</i> (without complication)	48 (94.0)	62 (91.1)	110 (92.5)

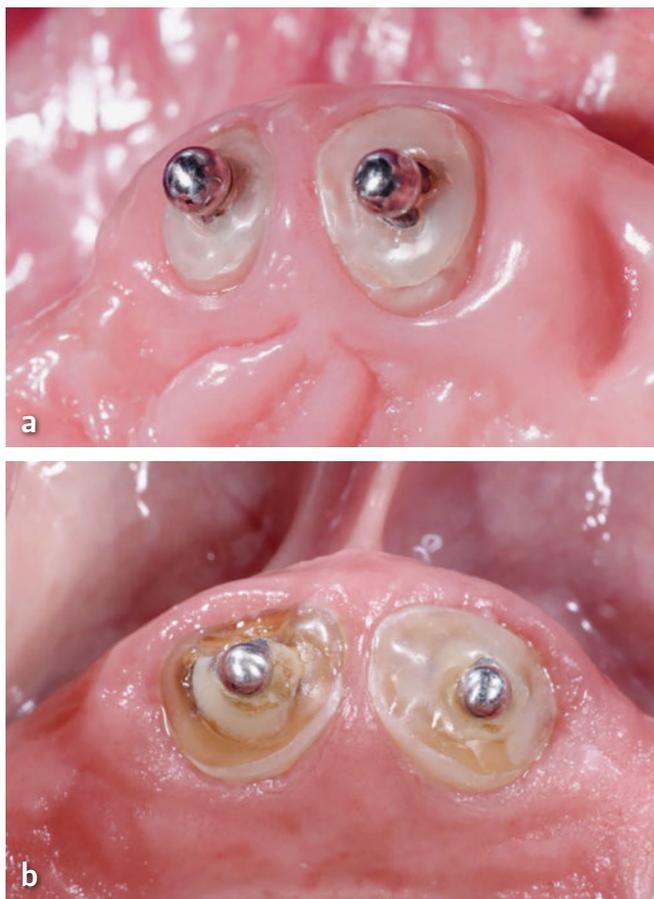


Fig. 1 a) Clinical situation of Dalbo®-Rotex® retention elements with composite resin covering after 6 months; b) clinical situation of a patient exhibiting Dalbo®-Rotex® retention elements on the roots 11 and 21 and a carious lesion in the area of exposed dentin in the root margin 11

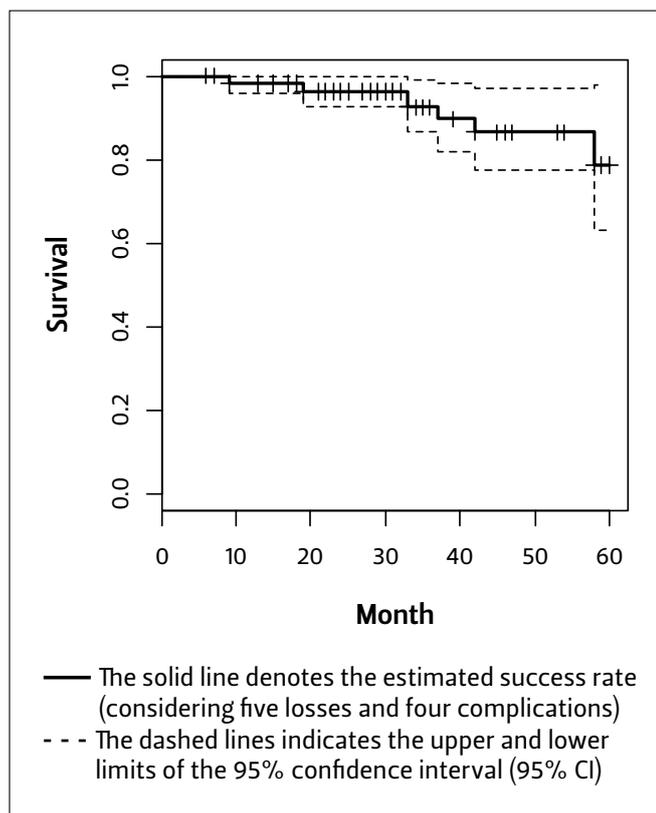


Fig. 2 Kaplan-Meier success rate (n = 119)

tures were cleaned three times a day by 22.8% of the patients, twice by 43%, and once by 29%; only 5.2% mentioned every few days. For cleaning of the prosthesis most frequently a denture brush was used, while for cleaning of the natural dentition a manual toothbrush as well as single-tuft and interdental brushes were applied. Plak-Out® gel (KerrHawe SA) was used daily by 44.7% of the respondents and weekly by 19.1%. EMOFLUOR®GEL (Dr. Wild & Co AG, Muttens, Switzerland) was applied once a week by only two of the twelve patients exhibiting carious REs. The majority of the patients (70.8%) stated that they wore the denture only during the day. The regression analysis revealed a clear trend that lower frequencies of oral hygiene (daily or every few days) in comparison with frequent oral hygiene (twice or three times a day) was associated with an almost threefold increased risk of a caries attack (OR 2.75; 95%CI: 0.99, 7.66; p = 0.052). Likewise a correlation became apparent between frequent oral hygiene and probing depths up to 3 mm at the maximum, while the risk of increased probing depths in the case of rare oral hygiene was elevated by a factor of 2.4 (OR 2.41; 95%CI: 0.98, 6.54; n.s.).

The evaluation of the VAS related to patient satisfaction demonstrated mainly positive ratings regarding the parameters denture comfort (handling and wearing comfort; on average 92.7% ± 13.6%), chewing efficiency (91.5% ± 14.1%), and prosthesis retention (92% ± 13.9%). Pain upon chewing was mentioned by 1.7% (± 4.2%) of the patients. In none of the parameters examined gender-specific differences emerged.

Discussion

The aim of the present clinical study was the follow-up evaluation of Dalbo®-Rotex® REs in patients of a private practice. A success rate of 96.3% after 24 months and a high patient satisfaction revealed that by means of prefabricated, chair-side inserted REs a simple and cost-effective fixation of removable dental prostheses is feasible.

The response rate in this retrospective follow-up evaluation amounted to 48.5% of identified patients and thus was relatively low. However, this still enabled to assess two thirds of the REs inserted initially. As reasons for the low return a retransfer to the family dentist, missing interest on the part of the patients, or bad payment behavior (debt enforcements) were determined. Also it has to be taken into account that the average observation time of 2.5 years does not yet allow a proposition concerning the long-term treatment possibilities.

Clinical long-term evaluations of Dalbo®-Rotex® REs are not reported in the literature. However, there are data of clinical follow-up examinations of conventional RPCs. In a retrospective follow-up investigation of 359 RPCs in the private practice comprising cases with an average observation time of 5.9 years, a survival rate of 93.3% and a success rate of 85.0% was determined (MERICSKE ET AL. 1993). Especially in elderly patients in frail health, a simple therapy and a short duration of treatment can be essential factors for the selection of chair-side inserted REs. In the patient population of the present study the average age was barely 70 years, and a rapid treatment as well as the cost aspect were at the forefront for the majority of the patients. Owing to the low cost of materials and manufacturing, a saving of expenses in the range of CHF 350-700 was estimated for direct REs with composite covering as against RPCs of a gold alloy (GERMANIER ET AL. 2006). However, in the case of exposed dentin surfaces high caries susceptibility was identified as a risk factor associated with the Dalbo®-Rotex® system (MERICSKE 1994), al-

though this can be reduced with the aid of a resin or amalgam covering (BRUNNER 1986, 1987). Alternative retention systems such as the TiCap® system or directly and indirectly manufactured root copings in combination with a Dalbo®-Rotex® RE enable a deliberate covering of the root surface, but necessitate a bigger effort associated with higher costs and, therefore, did not gain acceptance in everyday practice (TEUBNER & MARINELLO 2005; GERMANIER ET AL. 2006). In the present work, carious lesions were diagnosed in 16% of the roots treated with a Dalbo®-Rotex® RE, although the frequency of caries was somewhat lower (13%) on root surfaces covered with composite than on uncovered root surfaces (17%). Increased probing depths were found in 17% and bleeding on probing in about two thirds of the re-examined roots. Endodontic complications were not observed, which suggests a tight seal of the resin cements used in combination with adhesive fixation techniques. Similar frequencies of biological complications are reported in the literature concerning RPCs after an average of 5.9 years, i.e. caries in 5.9%, progression of periodontal disease in 4.2%, and endodontic complications in 1.4% of the cases (MERICSKE ET AL. 1993). In a follow-up evaluation of overdenture prostheses involving 135 tooth roots covered with amalgam or gold copings (12.3%), a minor caries prevalence of 2.7% was observed provided that the annual recall was complied with (ETTINGER ET AL. 1984). Among 137 root copings inserted in the student course of the Zurich university dental clinic, 20.4% exhibited carious lesions after an average observation time of 7.5 years; extractions were attributed to caries (3%) as well as endodontic (2%) and periodontal (3%) causes (SCHRIEBER 1999). Because of this high complication rate patients were summoned to recall more frequently, and upon a control after 14 years a lower caries prevalence of 10% of the abutment teeth was demonstrated (MUNZINGER 2006). Higher caries frequencies of 36% after 18 months (KELTJENS ET AL. 1990) and 16% after three years (BUDTZ-JØRGENSEN 1991) were reported regarding roots without covering of exposed dentin areas and overdenture prostheses. Upon a follow-up evaluation of RPCs at the Bernese university dental clinic no losses due to caries or other biological complications occurred within a period of two years. This finding was attributed by the authors to the fine-mesh recall and the short observation time (HUG ET AL. 2006). Especially in elderly and manually handicapped patients the personal oral hygiene is limited, and the check-up visits at the dentist's more likely are disregarded (STADELMANN ET AL. 2012). A frequent recall including oral hygiene instruction and fluoridation of exposed dentin areas hence is to be strongly recommended (NITSCHKE ET AL. 2014).

In the patients included in the present work, technical aftercare efforts involving activation or replacement of the female part concerned around 40% of the re-examined REs; fractures were rare, occurring in 3.4% of the cases and in patients showing parafunctions. GERMANIER ET AL. (2006) emphasized that the technically demanding screwing in of root abutments during cementation has to take place passively to avoid strains and reduce the risk of fractures. In accordance with the present data,

a previous follow-up evaluation of RPCs revealed 3.6% technical complications including root fractures, fractures of the REs, or loss of RPCs, whereas the frequency of activations of the female part was not documented (MERICSKE ET AL. 1993). Apart from the necessity of activation in over one third of the REs, wear of the Dalbo® ball occurred in 16% of the REs examined. This wear and tear between the female part and the patrix constitutes a frequent clinical problem, which particularly in divergent REs with axial deviations of over 20° leads to increased deterioration (LUDWIG ET AL. 2006). Replaceable activation aids available in newer female part systems facilitate aftercare and enable a rapid improvement of the retention (BÜTTEL ET AL. 2009). The high patient satisfaction found in the present work agrees with a survey of patients who rated their overdenture prosthesis supported by RPCs in regard to wearing comfort, chewing feeling, denture handling, and general satisfaction with values >80% on a VAS (HUG ET AL. 2006).

Conclusion

Dalbo®-Rotex® REs can be used as a simple and cost-effective fixation for removable dentures in the private practice. Due to the general caries susceptibility in combination with manual skills that at an advanced age are limited and entail a restricted oral hygiene, covering of exposed dentin areas with composite and regular aftercare including the application of fluoride are recommended.

Résumé

Le contrôle des éléments de rétention de Dalbo®-Rotex® dans un cabinet privé est l'objectif de la présente étude rétrospective. La majorité des éléments de rétention furent cimentés à l'aide d'un composite de fixation autoadhésif dont près de 40% des surfaces radiculaires exposées furent couvertes de composite supplémentaires. Au bout d'une période de 24 mois, il fut démontré auprès de 50 patients inclus un taux de réussite de 96,3% (taux de participation 48,5%). Ceci prouve qu'un ancrage simple et avantageux avec des éléments de rétention confectionnés et insérés de façon *chairside* est faisable pour les prothèses amovibles. Dans le cadre des traitements suivants, le remplacement des éléments de rétention étant nécessaire qu'une seule fois s'éleva à 12,3%, respectivement à 39,4% pour les remplacements répétés. Avec un quota de 3,4%, les fractures n'apparurent que rarement, affectant uniquement les patients atteints de parafunctions. Le contrôle de l'hygiène buccale fréquent fut en corrélation avec les profondeurs de sondage d'un maximum de 3 mm. Cependant, le risque concernant les profondeurs de sondage élevé augmenta d'un facteur 2,4 concernant les soins bucco dentaires rares. Les paramètres gestion et confort de port, sensation masticatrice et l'encrage de la prothèse furent surtout jugés positivement parmi les patients. Basé sur les données disponibles, le couvrage des surfaces radiculaires exposées à l'aide de composite et l'exécution régulière des contrôles de l'hygiène buccale contenant un nettoyage professionnel, l'application de fluorure et l'instruction d'hygiène bucco dentaire sont recommandables.

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