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Clinical Research

A Comparison of Conventional and New Rubber Dam Systems in Dental Practice

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Clinical Relevance

Rubber dam provides unrivaled isolation and infection control. Recent innovations in rubber dam design are intended to gain better acceptance among dentists.

SUMMARY

Objective: **Rubber dam is an important tool in dentistry—in the past as well as today. As a result of a lack of acceptance of the conventional system, introduced by Barnum in 1869, new systems were developed (eg, OptraDam® by Ivoclar Vivadent AG, Schaan, Liechtenstein). This system was advertised as being very comfortable and easy to use, without distracting clamps. The aim of this study was to investigate if a new rubber dam system would be better accepted by patients and dentists than the conventional one.**

Materials and Methods: **Two hundred patients from the Department of Conservative Dentistry and Periodontology received at least one treatment with the conventional rubber dam (Dental Dam, Coltène Whaledent, Langenau, Germany) and one with the new rubber dam (OptraDam®, Ivoclar Vivadent). Staff/students and patients were asked to complete questionnaires with regard to the advantages and disadvantages of the particular system after every treatment.**

Results: **Among patients, students, and dentists in the dental school environment there is a high degree of acceptance of rubber dam in general. During the study there were only very few situations in which neither of the systems could be used. The conventional rubber dam was preferred by all patients, students, and dentists ($p<0.0001$).**

Conclusion: **Our study confirms that there is a high degree of acceptance of the rubber dam when it is compulsory to use. The reasons for the refusal during the daily workload of a practice remain unclear, but appear to be**

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independent of the material or design available. A new design does not necessarily imply better acceptance.

INTRODUCTION

Rubber dam has been a controversial issue for many decades. Its use was, and still is, described as circuitous, time-consuming,[1] and costly. Nevertheless, rubber dam is still the most important tool with which to extend warranty with respect to antisepsis and moisture control as well as to protect patients from aspiration of endodontic instruments or toxic materials.[2-4]

In 1835, the first attempts were made to control moisture in the oral cavity during dental treatment. Dr Sanford Christie Barnum was the first dentist to use a thin piece of rubber to isolate teeth in 1869.[5] Barnum's method was soon officially adopted as a solution for the problem of moisture control. Only three years later the prevalence of rubber dam use was described as widespread.[5,6]

At the beginning of the 20th century, the enthusiasm for rubber dam was on the wane. Among the various reasons were the development of silver amalgam, the emergence of focal infections, and improved suction devices. Instead of rubber dam, cotton rolls and alcohol were recommended as alternatives.[6]

In 1931, Rule emphasized the danger of infection in a dentin wound due to opening the permeable dentin tubules during preparation and excavation.[6] Subsequently, several authors[6-8] postulated the renewed use of rubber dam. A growing number of patients, the simultaneous treatment of several patients, and improved dental materials seemed to be reasons to avoid rubber dam. Despite renewed efforts to remind dentists of the importance of rubber dam, most dentists were mainly concerned with the efficiency and profitability of their private practices.[9]

Over the last two decades, various researchers[1,10-17] have investigated the reasons for the rejection of rubber dam and potential improvements for better acceptance. Their results showed that dentists basically do not use rubber dam since they believe it to be too time consuming and cumbersome and because they believe that patients will not accept it. So it seems the arguments against using rubber dam have not changed over the past 140-plus years.

The emergence of infection control in dentistry due to life-altering infections, such as from hepatitis and human immunodeficiency virus, has led to the regular use of gloves, dental face masks, and protective goggles.[4] For some reason, rubber dam was not implemented,[3] despite being the most efficient tool. Furthermore, it protects the patient from aspiration or the ingestion of foreign items, such as endodontic files, etc.[18,19] Dental procedures are responsible for one-half of all aspirated items.[20]

In 2005, the dental enterprise Ivoclar Vivadent AG (Schaan, Lichtenstein) released a new rubber dam (OptraDam®). OptraDam® was supposed to represent a further development of the conventional system; first and foremost it was said to require no clamps or frame. The same year a DVD and publication ("Rubber dam in 100 seconds") was released by Johannes Müller and Norman Tischer.[21]

Since rubber dam is the gold standard at the university and because the dental staff is accustomed to its use, we hypothesized that the OptraDam®, with its new design, is likely to be superior to a conventional system (Dental Dam, Coltène Whaledent, Langenau, Germany) with respect to application, fixation, and patient comfort.

MATERIALS AND METHODS

From October 2007 to January 2008, 200 patients, 71 students, and three junior and two senior practitioners participated in our study. The study protocol was approved by the local ethics committee (No. 43/07). Conceptual design and conduct of the study were carried out according to the Declaration of Helsinki.

Prior to their treatment, all patients were informed about the necessity of rubber dam (eg, infection control and aseptic operation field). Dental treatment was to be carried out as usual except for the use of the rubber dam. The conventional and the new system were to be used alternately. There was a randomization with regard to which system to begin with (see Treatment Procedure). After every treatment questionnaires were filled out by patients, students, and dentists. There was one questionnaire for the patients, to be filled out immediately after the appointment, and two questionnaires (#1 and #2) for the students and dentists, the former to be completed after every treatment, the latter after completion of the study. Furthermore, there were information brochures for patients and students/dentists as well as a manual for the dental staff.

Of the 200 patients included in this study, 83 were male, 92 were female, and 25 offered no specification regarding gender. The gender of the remaining 25 patients could not be ascertained, since the evaluators were blinded. To be included in the study all patients had to speak and write German fluently in

order to be able to sign an informed consent for the study. Parents signed the consent form for any underage participants. Further inclusion criteria were at least two rubber dam treatments from October 2007 to January 2008. The most important exclusion criterion was a latex allergy, as the OptraDam® is not available in a latex-free model.

Patient Questionnaire

The patient questionnaire obtained information about age, gender, previous rubber dam treatments, and comfort of wearing rubber dams during the treatment. Patients could also comment on their treatment.

Dentist Questionnaire #1

Among information about the position in the Department of Conservative Dentistry (student or junior or senior practitioner) and professional experience, there were several multiple-choice questions. The questions covered potential difficulties with application and fixation of each rubber dam system, further necessary aids (clamps, wedges, etc), the indication for rubber dam use, and an estimation of whether the patient felt comfortable with the applied system.

Dentist Questionnaire #2

At the end of the study, all students and dentists who had participated completed a second questionnaire. Therein, they gave information about their personal preference in general and in detail and were asked to precisely state the advantages and disadvantages of each system.

Treatment Procedure

As the dental staff at dental schools is usually accustomed to rubber dam use, we intended to avoid the conventional system being used first as a result of habitual practice. For this reason, each of 300 patient questionnaires were marked with instructions to use either the conventional or the new system (150 new, 150 conventional), and each questionnaire was provided a study number. These questionnaires were then put into nontransparent brown envelopes and mixed extensively. Two-thirds of the envelopes were placed in the hall where the students perform their treatments and one-third at the dental chairs of junior and senior practitioners. When a patient was included in the study, one of the envelopes had to be opened and the first treatment had to start with the type of rubber dam marked on the questionnaire. For each consecutive treatment the other system had to be used. In case of further treatments both systems had to be used alternately.

After every treatment both patient and student/dentist completed the appropriate questionnaire. These were collected by the evaluators.

None of the questionnaires, including the one for the patients and both for the dental staff, were evaluated until the end of the study. For the evaluation only complete questionnaires were considered, with the sole exception that the patients' gender was not stated in 25 cases. These questionnaires were still included.

Statistical Analyses

All statistical analyses were performed with SPSS 13.0 (Statistical Package for the Social Sciences, Chicago, Ill, USA). Analyses were confined to simple cross-tabulations of the patients' and dentists' responses plus potential associated factors and appropriate follow-up comparisons wherever necessary. *p*-Values refer to chi-square analyses, if not stated otherwise. The threshold for statistical significance was set at the 95% probability level.

RESULTS

Of 498 patient questionnaires, 493 were included for evaluation. Five questionnaires were excluded as they did not contain any information about the rubber dam system used or the corresponding dentist questionnaire was missing.

Of 498 dentist questionnaires (#1), 493 were included. Again, five questionnaires were excluded, as they had no information about the dental staff or professional experience or because the corresponding patient questionnaire was not properly or completely filled out. All #2 (76) dentist questionnaires were included.

Patients

The youngest patient was 15 years old, the oldest 81 years old (mean, 45.76 years; median, 45.88 years) (Table 1). The most common indication for the use of rubber dam was adhesive dentistry (Table 1).

One hundred twenty-three patients received two treatments during the study; 77 received more than two treatments (Table 1). The general preference was 38.77% for the new system and 51.99% for the conventional system. Of the participants, 9.25% had no preference (Table 2). This result (conventional vs new) was statistically significant ($p<0.05$). Having

Table 1: *Demographic Data and Frequency of Application*	
Number of Patients, No.	200
Male	83
Female	92
No statement	25
Age, y	
Mean (male/female)	45.76 (44.09/44.26)
Median (male/female)	46.88 (42/49)
Indication for treatment, %	
Restorative dentistry	82.93
Endodontics	17.07
Frequency of application, per patient	
Two treatments	123
More than two treatments	77

more than two treatments did not change the patients' preference (ie, the choice of preference remained the same even after more than two treatments).

Gender had no influence on the preference (p=0.114), but age was statistically significant. Patients between 31 and 40 years of age were even more likely to opt for the conventional system ($p<0.05$, Bernoulli test) than were patients in all other subgroups.

Of all treatments, 246 were performed using the conventional rubber dam, and 247 were performed using the new system. The conventional system was deemed comfortable in 74.3% (183) and uncomfortable in 21.4% (53) of all cases. While this result was statistically significant ($p<0.001$), the results for the new system were nearly the same: 62.6% (155) of the time the new system was described as comfortable, and 36.6% (90) of the time it was described as uncomfortable ($p<0.001$). As a result of our study design it was not possible to pool the samples to see which system would generally be more comfortable for the patient.

Table 2: *Preference of Rubber Dam System*		
Preference	**Patients, %**	**Students/Dentists, %**
Conventional system	51.99	88.16
OptraDam®	38.77	9.21
No preference	9.25	2.63

In only 23 treatments was there a comment about why insertion or wearing of any rubber dam was uncomfortable. We therefore excluded this small number from statistical evaluation.

Dentist Questionnaire #1

The dental staff preferred the conventional rubber dam in general ($p<0.001$) (Table 2). There were no differences among the subgroups (students and junior and senior practitioners).

Students and junior and senior practitioners estimated that both systems were equally comfortable or uncomfortable for the patient. In 70% of all treatments the students and dentists assessed the comfort for the patient as comfortable or even very comfortable.

The insertion and fixation of both systems were assessed as easy ($p<0.0001$) for both conventional and new dams. The conventional rubber dam was never used without a clamp, whereas the OptraDam® needed a clamp only 48.1% of the time.

The most common patient characteristics that impeded application or fixation for both systems were very tight proximal contacts and short clinical crowns with no, or only slight, anatomical undercut.

Dentist Questionnaire #2

The results of this questionnaire confirmed that the dental staff preferred the conventional system (Figure 1). While 67 participants preferred the conventional rubber dam, only seven chose the OptraDam®, and two had no preference. This result was statistically highly significant ($p<0.0001$). The main advantages were the simple insertion and lack of difficulty when taking radiographs; the necessity of a clamp most often was stated as a disadvantage (Table 3). The OptraDam® outperformed the conventional system with regard to use in the anterior region, whereas it was considered difficult to apply on posterior teeth or when taking radiographs (Table 4).

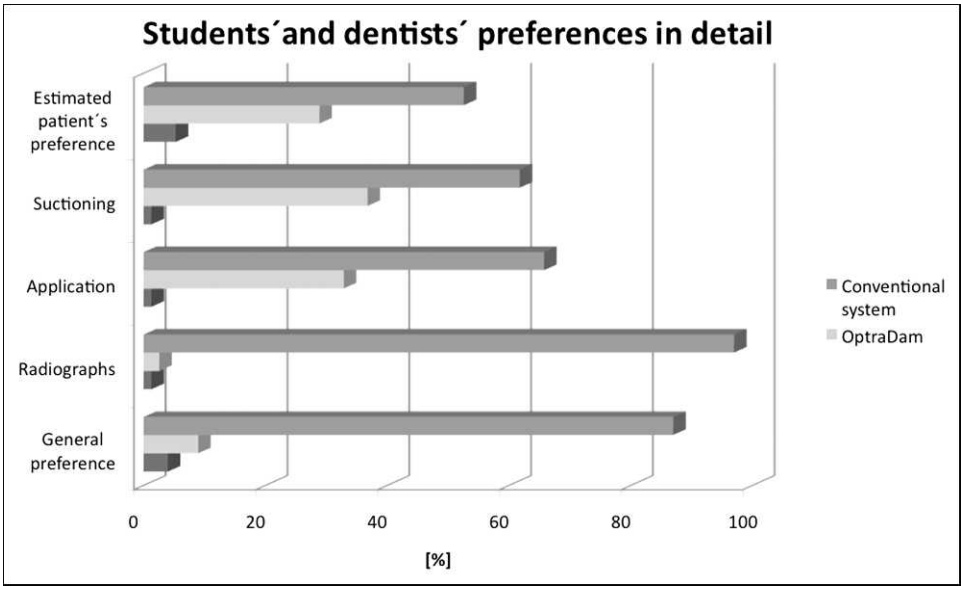

Figure 1. *After completion of the study, students, junior and senior practitioners assessed their preferences in detail.*

When comparing both systems in detail, the preference for the conventional system for taking radiographs was statistically significant ($p<0.0001$); results were statistically significant for applying ($p<0.01$) and for suctioning ($p<0.05$) as well (Figure 1).

DISCUSSION

Rubber dam has been a controversial issue. Its necessity in endodontics and restorative dentistry is all but beyond controversy at dental schools and in many specialist practices, but it is seldom used by general practitioners. This well-known deficit has led to further development of the conventional system. Most of the advancements in design were supposed to make the application and fixation easier, in order to gain better acceptance among dentists.[22,23] Beyond these innovations, there were reviews[24-35] published at periodic intervals to remind dentists of this underused tool. We investigated whether these enhancements made the rubber dam easier to use for dentists and whether the comfort was improved for patients.

Table 3: *The Three Most Frequently Stated Advantages and Disadvantages of the Conventional Rubber Dam (Students' and Dentists' Specifications)*

Advantages	
1.	Application, especially on side teeth, is easy
2.	Taking radiographs is not difficult
3.	Intraoral suctioning works well
Disadvantages	
1.	Necessity of a clamp
2.	Rips frequently
3.	Suctioning on the rubber dam is hindered

Table 4: *The Three Most Frequently Stated Advantages and Disadvantages of the OptraDam® (Students' and Dentists' Specifications)*

Advantages	
1.	Superior in the anterior region (especially upper front teeth)
2.	No clamps necessary
3.	Application is easier
Disadvantages	
1.	Inferior on posterior tooth isolation
2.	Difficult to take a radiograph
3.	Displeasing compression due to the inner arch

The study has limitations, of which the most important is that students do not have much professional experience. In most studies or surveys, which investigated rubber dam use among general dental practitioners and/or specialists, the participants had several years of practical experience. It is well known that the use of rubber dam is emphasized during the training conducted at the university, whereas many (general) dental practitioners do not use it (any longer) in their private practice.[14,36-38] The skills required to utilize rubber dam thoroughly might therefore be better developed during university studies than after several years in a dental practice. In our study there were 34 inexperienced students (fourth-year students), 37 experienced students (fifth-year students), three junior practitioners with professional experience measuring between two and eight years, and two senior practitioners with professional experience of three and 25 years, respectively. Nearly half of the participating dental students (ie, the fourth-year students) were not accustomed to any of the rubber dam systems, and they were introduced to both at the same time. Therefore, it should not be reasoned that a certain habituation effect, with regard to the conventional system, played an important role during the study. The comparison of these four groups did not show any statistically significant effects with regard to preference. We concluded that a habituation effect could be disregarded.

Another limitation of this study may be that patients at university clinics are sometimes referred to as non-representative; our results may therefore be inevitably limited as a result of the selected study population. But in our clinic there is an obvious difference between patients treated by students and those treated by junior and senior practitioners. Therefore, our study population might be closer to a representative cross-section of a population than are populations of other studies conducted at dental schools.

Our results showed that only very few patients felt uncomfortable when rubber dam (regardless of the system) was used during their treatment. It has been known for many years that a remarkable number of patients relax measurably when rubber dam is used (eg, the cardiovascular parameters decrease and perspiration decreases).[39] Based on the specifications of all participants (students, dentists, and patients), the argument that patients would not accept rubber dam could not be sustained. This is in contrast to a recent publication,[40] which stated that undergraduate students were not convinced that the rubber dam can be an effective and efficient tool, except for in endodontic therapy. The authors of this study reported that they even believe that their patients (adults and children) would prefer treatment without rubber dam. On the contrary, there have actually been a number of publications[34,39,41] displaying patient acceptance.The reasons for these conflicting results cannot be resolved with one single study. A multicenter study, a larger patient cohort, and a study involving several groups of dentists with varying degrees of professional experience might offer the most suitable design with which to explain this discrepancy.

We could not confirm the advantages of the OptraDam®, which were advertised at the time of our study. In particular, the application on posterior teeth was more difficult than expected. Although half of the participating dental staff was introduced to both systems at the same time, they preferred the conventional dam. The OptraDam® system has been developed further since our study. The improvements are said to reduce the necessity of a clamp for posterior teeth and to facilitate taking radiographs. It might be interesting to see how these innovations work in a daily routine. When we conducted our study, the newer system was inferior to the conventional system (Figures 2 and 3).

We could not prove the hypothesis that a new rubber dam system is superior to the conventional one. The decision to work within an isolated field seems to be independent of traditional or newer aids, but rather reflects a matter of attitude. It may be doubted whether the true reasons for rubber dam rejection are really based on design and handling.

Figure 2. *For the treatment of posterior teeth, the conventional system was mainly preferred – despite the necessity of a clamp.*

Figure 3. *The OptraDam® was especially preferred for the treatment of anterior teeth.*

Our results showed that there is good patient acceptance of rubber dam when the device is thoroughly explained. In this context it cannot be understood that skills acquired at university become stunted in dental practice. Ergonomic aspects and aseptic techniques are refuted in favor of alleged economic reasons. The fact that rubber dam protects the patient from mechanical, toxic, and infectious noxa and reduces the bacterial exposure of the surrounding area is ignored,[2-4,42,43] although all of these aspects should be part of the general protection afforded by dentists and auxiliary staff. Quality issues have to be considered as well, as safety concerns arise for both the profession and the patients due to the refusal to utilize rubber dam.[1] It would be interesting to reevaluate whether the new(er) OptraDam®, with the changes mentioned before, works out better for daily routines.

CONCLUSION

It has been repeatedly reported that among patients there is a high acceptance of rubber dam use. Our results indicate that there is remarkable acceptance among students and dentists as well. During the study, there were only very few situations in which neither of the systems could be used or in which the systems were described as difficult to apply. In the dental school environment, comparison of the conventional and new rubber dam systems showed that the conventional one was preferred.

Our study confirms that there is a high degree of acceptance of rubber dam when its use is compulsory, and this acceptance is independent of the material or design available.

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REFERENCES

1. Lynch CD & McConnell RJ (2007) Attitudes and use of rubber dam by Irish general dental practitioners *International Endodontic Journal* **40(6)** 427-432.
2. Freitag M & Hellwig E (2006) Update zum Thema Kofferdam *Zahnärztliche Mitteilungen* **96(1)** 20-26.
3. Costello MR (2006) Dental dams: The secret tool for infection control *Compendium of Continuing Education in Dentistry* **27(3)** 196-199.
4. Harfst SA (1991) Personal barrier protection *Dental Clinics of North America* **35(2)** 357-366.
5. Winkler R (1991) [Sanford Christie Barnum—Inventor of the rubber dam] *Die Quintessenz* **42(3)** 483-486.
6. Winkler R (1989) *Kofferdam in Theorie und Praxis* Quintessenz-Verlag, Berlin.
7. Black GV (1936) *Operative Dentistry* Medico Dental Publishing Company, Chicago, Ill.
8. Black GV (1914) *Der Kofferdam. Konservierende Zahnheilkunde* H. Meusser Verlag, Berlin.
9. Ireland L (1962) The rubber dam *Texas Dental Journal* **80(3)** 6-15.
10. Brackett WW, Scheid RC, Johnston WM & Cieslak JH (1989) Attitudes of operative dentistry faculty toward rubber dam isolation *Journal of Dental Education* **53(12)** 725-726.
11. Brennan EP (1991) The use of rubber dam in the UK *British Dental Journal* **170(5)** 175.
12. Chapman TE (1993) Why no dental dam? *Journal of the American Dental Association* **124(4)** 16.
13. Cosgrove DJ (1968) Rubber dam in routine dentistry *The New Zealand Dental Journal* **64(298)** 246-265.
14. Gergely EJ (1989) Desmond Greer Walker Award. Rubber dam acceptance *British Dental Journal* **167(7)** 249-252.
15. Hagge MS, Pierson WP, Mayhew RB, Cowan RD & Duke ES (1984) Use of rubber dam among general dentists in the United States Air Force dental service *Operative Dentistry* **9(4)** 122-129.
16. Joynt RB, Davis EL & Schreier PH (1989) Rubber dam usage among practicing dentists *Operative Dentistry* **14(4)** 176-181.
17. Marshall K & Page J (1989) Rubber dam acceptance *British Dental Journal* **167(9)** 304.
18. Carrotte P (2004) Endodontics: Part 6. Rubber dam and access cavities *British Dental Journal* **197(9)** 527-534.

19. Zitzmann NU, Elsasser S, Fried R & Marinello CP (1999) Foreign body ingestion and aspiration *Oral Surgery Oral Medicine Oral Pathology Oral Radiology and Endodontics* **88(6)** 657-660.

20. Limper AH & Prakash UB (1990) Tracheobronchial foreign bodies in adults *Annals of Internal Medicine* **112(8)** 604-609.

21. Müller J & Tischer N (1995) Kofferdam in 100 Sekunden *Die Quintessenz* **56(11)** 1113-1120.

22. Ahlers MO (2003) A new rubber dam frame design—Easier to use with a more secure fit *Quintessence International* **34(3)** 203-210.

23. Kontakiotis E (1995) A novel rubber dam system for the simultaneous isolation of teeth and gingival tissues *Quintessence International* **26(6)** 395-398.

24. Zeppenfeld W (1985) [Rubber dam—Good practice in 30 seconds]. *Die Quintessenz* **36(9)** 1691-1697.

25. Winkler R (1988) [What should the dental assistant know about the rubber dam? (I)] *Quintessenz Journal* **18(10)** 955-968.

26. Winkler R (1988) [What should the dental assistant know about the rubber dam? (II)] *Quintessenz Journal* **18(11)** 1063-1070.

27. Winkler R (1988) [What should the dental assistant know about the rubber dam? (III)] *Quintessenz Journal* **18(12)** 1155-1163.

28. Weisman MI (1991) Remedy for dental dam leakage problems *Journal of Endodontics* **17(2)** 88-89.

29. Urrutia N (1979) [How current is the rubber dam method?] *Stomatologie der DDR* **29(6)** 484-488.

30. Terry DA (2005) An essential component to adhesive dentistry: The rubber dam *Practical Procedures and Aesthetic Dentistry* **17(2)** 106-108.

31. Stibbs GD (1951) Rubber dam *Journal (Canadian Dental Association)* **17(6)** 311-312.

32. Stebner C (1988) Apply the rubber dam *Journal of the American Dental Association* **116(7)** 820-822.

33. Stebner C (1988) Value of rubber dams *Journal of the American Dental Association* **116(1)** 16.

34. Slaus G, Minoodt I & Bottenberg P (2005) [The rubber dam, a problem for the dentist or the patient?] *Revue Belge de Médicine Dentaire* **60(4)** 301-309.

35. Schulein TM (1988) The rubber dam—Better than ever *The Iowa Dental Journal* **74(4)** 36-39.

36. Christensen GJ (1994) Using rubber dams to boost quality, quantity of restorative services *Journal of the American Dental Association* **125(1)** 81-82.

37. Whitworth JM, Seccombe GV, Shoker K & Steele JG (2000) Use of rubber dam and irrigant selection in UK general dental practice *International Endodontic Journal* **33(5)** 435-441.

38. Soldani F & Foley J (2007) An assessment of rubber dam usage amongst specialists in paediatric dentistry practising within the UK *International Journal of Paediatric Dentistry* **17(1)** 50-56.

39. Schriever A, Eißner D & Heidemann D (1998) Untersuchung zur Akzeptanz von Kofferdam mittels Streßparameter *Deutsche Zahnärztliche Zeitschrift* **53(8)** 513-516.

40. Ryan W & O'Connel A (2007) The attitudes of undergraduate dental students to the use of the rubber dam *Journal of the Irish Dental Association* **53(2)** 87-91.

41. Stewardson DA & McHugh ES (2002) Patients' attitudes to rubber dam *International Endodontic Journal* **35(10)** 812-819.

42. Cochran MA, Miller CH & Sheldrake MA (1989) The efficacy of the rubber dam as a barrier to the spread of microorganisms during dental treatment *Journal of the American Dental Association* **119(1)** 141-144.

43. Kamann WK (1998) [The rubber dam—The change in indications and technics] *Schweizer Monatsschrift für Zahnmedizin* **108(8)** 771-781.