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A Survey on Prevalence, Causes and Prevention of Post-cementation Hypersensitivity

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ABSTRACT

This study evaluated the prevalence and causes of post-cementation sensitivity and possible prevention measures according to the experience of dentists through an internet survey. A questionnaire was prepared with 25 items based on a survey introduced by Rosenstiel and Rashid. An online site was created for the participation to the survey. A total of 322 participants responded the questionnaire. The results of the questionnaire indicated the amount of tooth preparation (42.1%) is the most frequent reason for hypersensitivity followed by water-cooling with pressure (11.2%) and provisionals (10.9%). "Very important" response for tooth reduction, time before cementation, overheating, luting agent, occlusion and provisionals were found to be of statistical significance ($p<0.001$). Comparing respondents' opinions the incidence of post-cementation sensitivity appears to be underestimated. Tooth reduction, preparation under high volume spray and quality of provisional restorations was considered to have a significant impact on the incidence of post-cementation sensitivity according to the dentists surveyed across Turkey. Respondents to the questionnaire considered the use of antimicrobial, desensitizing, resin bonding, hemostatic agents, varnishes, type of liner material, rotary instruments to be less effective for prevention of post-cementation sensitivity.

INTRODUCTION

In current dental practice, missing teeth are often replaced by metal-ceramic fixed dental prosthesis (FDPs) that requires removal of certain amount of dental structures to gain space for the framework and the veneering material.[1] However, it is essential to preserve the vitality of the abutments during this procedure. Provisional fixed dental prosthesis luted with temporary luting cements significantly serves for this purpose.[2] However, post-cementation hypersensitivity (PCH) that is the sensitivity in response to hot or cold stimulation of a tooth after cementation of the FDP could not be completely avoided.[3]

Since it impairs quality of life of the patients, several methods have been proposed to eliminate PCH.[4] The majority of the work in this field focused on the cement type, cavity size and their impact on PCH.[5-9] Apart from luting cement, numerous other factors have been attributed to PCH such as the type and the use of desensitizers, resin bonding agents, time required for tooth preparation, time until temporary cementation, rotary instruments, microbiological contamination, heat produced during preparation and desiccation, presence of premature contacts in occlusion with provisional and definitive FDPs and experience of the practitioner.[4,10-16]

While great efforts have been made to understand the causes of PCH, there is no concept that is broadly accepted and employed worldwide. Thus, many clinicians are unsure as to which methods are supported by scientific data and, therefore, should be adopted in everyday practice.[4]

The objectives of this study therefore were to gain insights into the prevalence, causes and prevention methods used to address the risks of PCH through an online survey in order to minimize the risk of PCH.

MATERIALS AND METHOD

STUDY DESIGN

This cross-sectional study was carried out among the dentists practicing in different dental settings including private clinics, universities and public dental health care centers across Turkey. In January 2013, a questionnaire was distributed by electronic mail to 3000 dentists.

The online questionnaire prepared was based on a previous study after Rosenstiel and Rashid.[4] The original English version of this questionnaire was translated to Turkish, and Vet [17] recommendations were followed. The process involved 1) direct translation from English into Turkish by two native speakers of Turkish working independent from one another; 2) synthesis of the two translations; 3) backward translations from Turkish into English by two independent native speakers of English; 4) review and reconciliation of the backward translations; and 5) pilot-testing on a random sample of 15 students, after which the final editing took place.

The questionnaire contained 25 items *(Figure 1*). The first six items aimed to collect basic information about the respondents, such as contact details, area of residence and area of specialty. The next two questions sought to acquire data on the number of cemented abutments that the respondent performed per month and the incidence of PCH. The last remaining 17 questions targeted to elicit information about the experience and perception of the participants as regards to PCH. Since the respondents completed the questionnaire online, their IP addresses were recorded in order to ensure that each participant completed only one survey.

The last 17 questions were multiple-choice and the participants were asked to select one of the four responses: “have not tried,” “have tried but not important,” “important” and “very important.” Furthermore, they were asked to provide their opinion on what factors are most likely to induce PCH. One additional question sought to gather the perceptions of the respondent independent from the items involved in the questionnaire.

1 - E-mail adress
2- Place of Location
3- Gender
4- Graduation Year
5- Province
6- The organization where s/he works
Private practice
State hospital
University
7- Howmany crowns do you cement on abutment within a month?
8- Before you made changes, what percentage of your crown/FPD patients had hypersensitivity?
0%, 1-2%, 3-5%, 6-10%, 10-20%, 20-40%, more than 40%
Please rank the following as being important in reducing/eliminating hypersensitivity in your practice as very important, important, have tried but not important, have not tried.
9 - Use of antimicroabial (e.g., clorhexidine) before cementing.
Very important
Important
Have tried but not important
Have not tried
10 - Use of resin bonding agent before cementing
Very important
Important
Have tried but not important
Have not tried
11 - Avoiding bacterial contamination during cementing
Very important
Important
Have tried but not important
Have not tried
12 - Choice of liner material (e.g., amalgam vs glass ionemer)
Very important
Important
Have tried but not important
Have not tried
13 - Use of desensitizing chemicals (e.g., Gluma) before cementing
Very important
Important
Have tried but not important
Have not tried
14 - Not desiccating (overdrying) before cementing
Very important
Important
Have tried but not important
Have not tried
15- Choice of hemostatic agent for impression making
Very important
Important
Have tried but not important
Have not tried
16 - Material used for cementation (e.g., ZincPhosphate cement, CIS)
Very important
Important
Have tried but not important
Have not tried
17 - Careful attention to occlusion
Very important
Important
Have tried but not important
Have not tried
18 - Using a well-made provisional (temporary) crown
Very important
Important
Have tried but not important
Have not tried
19 - Choice of rotary instrument (bur)
Very important
Important
Have tried but not important
Have not tried
20 - Time between preparation and cementation
Very important
Important
Have tried but not important
Have not tried
21 - Amount of tooth reduction
Very important
Important
Have tried but not important
Have not tried
22 - Use of varnish before cementing
Very important
Important
Have tried but not important
Have not tried
23 - Tooth preparation under high volume water sprey
Very important
Important
Have tried but not important
Have not tried
24- Which one is the most important single factor in preventing post-cementation sensitivity of crowns?
Antimicrobial
Bonding agent
Contamination
Core material
Desensitizing chemicals
Dessicating
Hemostatic agent
Luting agent
Occlusion
Provisional crown
Bur type
Time between preparation and cementation
Tooth reduction
Varnish
High volume water spray
25 - Other procedure or materials that have helped reduce post-cementation sensitivty for tooth prepartion for crowns

Figure 1: Questionnaire form used in this study.

QUESTIONNAIRE ADMINISTRATION

Dillman’s Tailored Design Method was used that is the current standard for conducting internet surveys.[18] Five points of contact were practiced for the questionnaire administration by two researchers: 1) advanced notification by electronic mail (e-mail) 2 to 5 days prior to receiving the survey; 2) an e-mail with a link to the internet survey; 3) another e-mail with a link to the survey after 6 weeks; 4) a further e-mail with a link at 12 weeks; and 5) final e-mail to non-responders. The study stopped 1 week after the final reminder e-mail.

Primary response rates were calculated based on the number of response to the first notification. Statistical analysis

Statistical analyses were performed using the Statistical Package for the Social Sciences (version 18.0, SPSS Inc, Chicago, IL, USA). The responses of the participants to the questionnaire items were analyzed using Fisher’s exact test. P values less than 0.05 was considered to be statistically significant.

RESULTS

In total, 322 valid responses were received. Of those surveyed, 46.3% estimated the incidence of PCH in their practice between 0-5 %, 19.6% between 1-2%, 22% between 3-5%. Only a small number (4.7%) claimed no incidences of PCH *(Figure 2*).

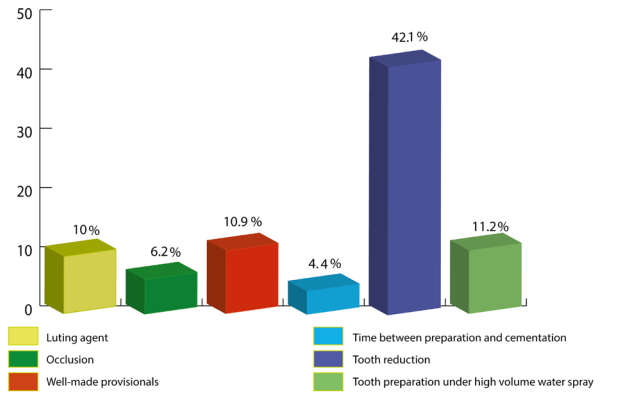

Figure 2: Selection of the respondents as "six most important" single factors in controlling post-cementation hypersensitivity ($p<0.001$).

The "most important" factors causing PCH was reported to be tooth reduction (42.1%) followed by tooth preparation under high volume water spray (11.2%) and quality of provisional FDPs (10.9%) (*Figure 3*). A range of factors, such as premature contacts in occlusion, time between preparation and cementation, tooth reduction and tooth preparation under high volume water spray were all considered to be "very important" by more than 60% of the respondents. While luting agents were considered to be "very important" by more than 50% and type of rotary instruments were considered to be "very important" by more than 35% of the respondents (*Figure 4*)

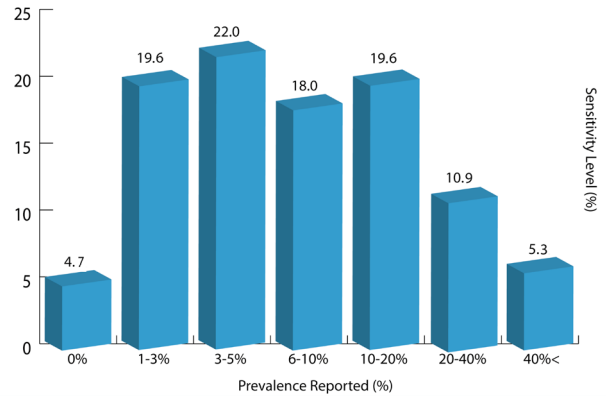

Figure 3: The incidence of post-cementation hypersensitivity perceived by the dentists responded to the questionnaire (N=322).

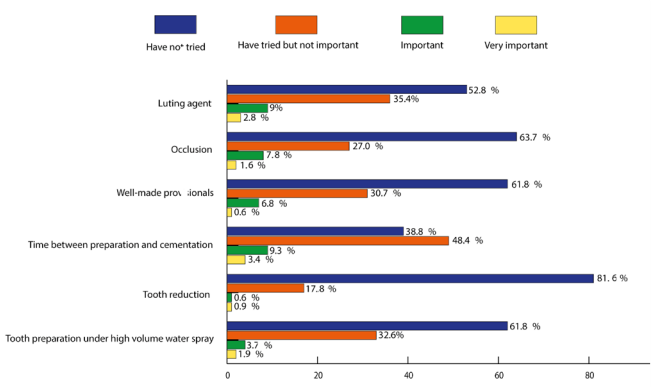

Figure 4: Six most important factors according to the responses for being "very important", "important", "have tried but not important" and have not tried" as regards to measures for prevention of post-cementation hypersensitivity.

Of the various factors listed, the least identified ones under "most important" category were the use of hemostatic agents, liner material, antimicrobial agent, rotary instrument type and use of varnish. The use of varnish, hemostatic agents, desensitizing agents, resin bonding agents, antimicrobial agent failing to desiccate before cementing, choice of core material, were considered "very important" by less than 20% of dentists.

Approximately 15% of the respondents provided additional comments in the field entitled: "Other procedures or materials that have helped reduce post-cementation sensitivity of crowns." Of these responses, the factors that were most commonly named were polymerization of the resin cement, low laser applications, avoiding acid etching, use of new bonding systems and magnified loops.

DISCUSSION

Full coverage FDP is one of the most commonly used treatment modality for replacement of missing teeth that often involve preparation of vital abutments to support the pontic and the retainers. A provisional fixed prosthesis is cemented during the interim period between the tooth preparation and cementation of final FDP. Postoperative sensitivity after cementation of FDP is a common complaint especially in cases where the abutments have vital pulp.[4] Brannstrom[3] suggested the following precautions prior to definitive cementation in order to reduce the risk of an inflammatory response in the pulp: 1) The provisional crown should be well fitting, covering cervical dentin but not impinging on the periodontal tissues and the definitive crown should be cemented as soon as possible, 2) The superficial smear layer should be removed and the dentin surface should be treated with an antibacterial solution before the provisional crown is placed, 3) To decrease dentinal permeability under the provisional crown, the dentinal surface should be covered with a liner that can be easily removed before final cementation, 4) To ensure optimal micromechanical bonding,

the dentin surface should be thoroughly cleaned, and the dentin should be kept moist until cementation, 5) The occlusion should be carefully checked before cementation of the crown.

Dental treatments based on actual knowledge have more favorable prognosis and reduce the risk of treatment failures or complications. When FDPs are indicated to replace missing single tooth especially in young patients, most of the time the abutment teeth are vital. In such clinical situations, the dentist has to make the critical decision whether to carry out elective endodontic treatment for the vital abutments or to try and preserve the pulp vitality.[19,20] A study carried out by Rosenstiel *et al*[12] showed that the incidence of post-operative complications is usually underestimated by most dentists. Therefore, in the present study, prevalence, causes and prevention of PCH were evaluated from the perspective of the dentists.

Numerous studies between 1993 and 2000 sought to understand how luting cements, such as zinc oxide, glass ionomer and zinc phosphate, contribute to PCH.[5-10,13] The possible factors for PCH were mainly due to tooth reduction, time until cementation, overheating, luting agent, occlusion and provisional FDPs according to the respondents. These constituted 84.7% of the factors that the participants considered "very important" and were found to be of statistical significance.

In a study by Johnson *et al*. in the 1990s, the incidence of patient sensitivity following restorations was around 25%. In other studies this incident was reported to be 20%[5] and 10%.[7] According to the results of the survey conducted in the present study, 46.3% of respondents estimated the incidence of PCH in their practice to be between 0 and 5%. These figures are lower than the findings of Rosenstiel and Rashid where 68% of respondents estimated the PCH between 0-2%.[4] The differences in the incident rates described by earlier studies and that of the present study and the work of Rosenstiel and Rashid can be attributed to variations in the methodologies used in the research.[5-7] Additionally, one other study performed by Danesteh and Ahmad[21] in Kermanshah city in Iran showed that 67.4% of dentists rarely or occasionally reported PCH.

Murray *et al*.[10] and Camps *et al*.[11] described the role of tooth reduction being of significance for the incidence of PCH. According to these studies, there is an increased reactionary dentin formation in deep preparations and 60% of the teeth prepared 0.5 mm close to the pulp exhibit a severe pulpal reaction. On the other hand, of those treated cavities having remaining dentin thickness greater than 1 mm, only 5% exhibited a severe reaction.[10,11]

Rosenstiel and Rashid reported that 47% of the dentists surveyed perceived that the amount of dentin removed during cavity preparation played a "very important" role in PCH, while 44% claimed it being "fairly important".[4] In present study, 81.1% of respondents claimed that the amount of tooth reduction was "very important", while 17.4% of respondents found this factor "important." As such, the findings of the two studies are largely in agreement.

A further factor that is considered to have an impact on PCH is the time between preparation and cementation. On the study of Rosenstiel and Rashid, only 13% of the dentists in North America perceived this factor "very important", 37% "fairly important," and 37% "not important." Likewise, in the present study, 38.8% of the Turkish dentists surveyed perceived the time between preparation and cementation being "very important" and 48.4% "important" for the incidence of PCH.

During the preparation of a tooth for restorative procedures, a large amount of heat is generated where a direct link between this heat and pulpal damage has been postulated, namely the higher the temperature the pulp reaches, the higher the amount of pulpal damage.[14] According to the results of the survey from Rosenstiel and Rashid, 63.5% of the North American dental practitioners found this factor "important" in the development of PCH, while 6.6% of those questioned believed that it was "not important" or "not tried."[4] On the other hand, in the present study, 61.8% of the Turkish dentists surveyed believed that tooth preparation under high-volume water spray was a "very important" factor, 32.6% said it was "important".

FDPs with high vertical dimension or premature contacts can also cause PCH of especially anterior teeth.[22] In the survey of Rosenstiel and Rashid, 88% of the dentists in North America reported this factor being "very important".[4] Similarly, 67% of those questioned stated that the use of a well-made provisional restoration being "very important" in reducing sensitivity. This figure was higher in the survey of Danesteh and Ahmad,[21] with 90.7%. In the present study, 63.7% of the respondents scored this item as "very important", being slightly less than those of other surveys.

Numerous studies stressed that the luting agents are also responsible for PCH.[5-7,9,13,23] In a recent clinical study, the effects self-adhesive resin cement and a resin modified glass-ionomer cement (RMGIC) were compared in regard to causing PCH.[24] with the latter caused more PCH. One other clinical study compared PCH after cementation with either conventional glassionomer cement (GIC) or resin cement where the self-adhesive resin cement caused less PCH.[25] Moreover, they also suggested that in case GIC is used as a cement, patients should be informed about the possible PCH for a longer period than with resin cement. Recently, in a prospective clinical study, clinical performance and PCH incidence with bioactive dental luting cements has been studied.[26] The study was performed on 38 crowns and FDP abutments in 17 patients. As a result only four patients reported low levels of PCH that disappeared after occlusal adjustment or without intervention within one month. Similarly, PCH was studied after the use of two self-adhesive resin cements for cementing FDPs on 50 abutments (Breeze, Pentron Clinical Technologies, Wallingford, Conn., and RelyX Unicem, 3M ESPE, St. Paul, Minn., USA) and an etch-and-rinse based conventional resin cement (RelyX ARC, 3M ESPE).[27] The incidence of PCH was significantly lower with the self-adhesive cements compared to the conventional one.

Rosenstiel and Rashid reported that 59% of respondents considered luting agent being "very important" PCH. In the present study, the choice of luting agent was considered "very important" by 52.8% and "important" by 35.4% of the respondents, summing up being considerably high. In the present study, dentists were not asked the type of luting agent they use. Therefore, an association between the type of cement and PCH could not be identified.

Hemostatic agent, liner material, rotary instrument type, time between preparation and cementation, and varnish use were considered "very important" by less than 20% of dentists for prevention post-cementation sensitivity which is line with the previous survey.[4]

It is important to achieve the highest response rate possible to limit non-response bias in health-care surveys. Ho *et al*[28] commented in 2007 that the main threat to the validity of survey findings arises from low response rates. One of the limitiation of this survey, is the low response rate to the internet questionnaire despite the efforts spent to make the questionnaire easy to use, along with inclusion of a link to the Web site in the invitation e-mail. Although recommendations were followed closely for conducting Web surveys suggested by Dillman *et al*.,[18] the response rate were comparable to the reported electronic and postal mail response rates. One reason may be that participants tend to be worried about computer viruses and delete e-mails that are unsolicited or those received from unknown persons.[29] The low rate of response also could be attributed the type of survey that is used. Previous studies showed a higher response rate among health-care professionals to conventional paper version than to the Web questionnaire.[29-31] Another reason for the low rate of response could be the workload of the dentists. Response rates to surveys, especially among physicians, are known to be suboptimal due to their heavy workload.[32] The return rates have been especially low in surveys of surgeons ranging between 15 and 77%.[33,34] The number of surveys to which dentists are subjected is unknown. Nonetheless, as early as 1993, Horner *et al*[35] commented that the general dental practitioners were suffering from 'questionnaire fatigue' ". In addition to surveys by academic institutions, dentists regularly receive requests to complete commercial surveys. Therefore, it is not surprising that non-response is considered to be a shortcoming of many surveys. Many authors have drawn attention to low response rates as sources of bias in surveys of health care professionals[36,37] and this survey could also not be excluded from this statement with almost 10-fold less response compared to the initial number of e-mail invitations sent. Nevertheless, the trends observed may be useful in developing devices or materials that may eventually decrease PCH in prosthetic dentistry.

CONCLUSIONS

Tooth reduction, preparation under high volume spray and quality of provisional restorations was considered to have a significant impact on the incidence of post-cementation sensitivity according to the dentists surveyed across Turkey. Respondents to the questionnaire considered the use of antimicrobial, desensitizing, resin bonding, hemostatic agents, varnishes, type of liner material, rotary instruments to be less effective for prevention of post-cementation sensitivity.

REFERENCES

1. Cheung GS, Lai SC, Ng RP. Fate of vital pulps beneath a metal-ceramic crown or a bridge retainer. *Int Endod J* 2005;**38**:521-530.
2. Akova T, Ozkomur A, Dundar C, Aytutuldu N. Intrapulpal heat generation during provisionalization: effect of desensitizer and matrix type. *J Prosthodont* 2008;**17**:108-113.
3. Brannstrom M. Reducing the risk of sensitivity and pulpal complications after the placement of crowns and fixed partial dentures. *Quintessence Int* 1996;**27**:673-638.
4. Rosenstiel SF, Rashid RG. Postcementation hypersensitivity: scientific data versus dentists' perceptions. *J Prosthodont* 2003;**12**:73-81.
5. Johnson GH, Powell LV, DeRouen TA. Evaluation and control of postcementation pulpal sensitivity: zinc phosphate and glass ionomer luting cements. *J Am Dent Assoc* 1993;**124**:38-46.
6. Bebermeyer RD, Berg JH. Comparison of patient-perceived postcementation sensitivity with glass-ionomer and zinc phosphate cements. *Quintessence Int* 1994;**25**:209-214.
7. Metz JE, Brackett WW. Performance of a glass ionomer luting cement over 8 years in a general practice. *J Prosthet Dent* 1994;**71**:13-5.
8. Jokstad A, Mjor IA. Ten years' clinical evaluation of three luting cements. *J Dent* 1996;**24**:309-315.
9. Kern M, Kleimeier B, Schaller HG, Strub JR. Clinical comparison of postoperative sensitivity for a glass ionomer and a zinc phosphate luting cement. *J Prosthet Dent* 1996;**75**:159-162.
10. Zach L, Cohen G. Pulp response to externally applied heat. *Oral Surg Oral Med Oral Pathol* 1965;**19**:515-530.
11. Brannstrom M. The effect of dentin desiccation and aspirated odontoblasts on the pulp. *J Prosthet Dent* 1968;**20**:165-171.
12. Dahl BL. Dentine/pulp reactions to full crown preparation procedures. *J Oral Rehabil* 1977;**4**:247-254.
13. Quarnstrom F, Collier N, McDade E, McLean K, Munk A, Nicholls J. A randomized clinical trial of agents to reduce sensitivity after crown cementation. *Gen Dent* 1998;**46**:68-74.
14. Camps J, Dejou J, Remusat M, About I. Factors influencing pulpal response to cavity restorations. *Dent Mater* 2000;**16**:432-440.
15. Murray PE, About I, Lumley PJ, Smith G, Franquin JC, Smith AJ. Postoperative pulpal and repair responses. *J Am Dent Assoc* 2000;**131**:321-329.
16. Rosenstiel SF, Land MF, Fujimoto *J. Contemporary Fixed Prosthodontics: Mosby Elsevier*; 2016. p.792-828
17. de Vet HCW, Terwee CB, Mokking LB, Knol DL. Measurement in medicine : a practical guide. Cambridge: *Cambridge University Press*; 2011. p.30-60

18. Dillman DA, Smyth JD, Christian LM. Internet, phone, mail, and mixed-mode surveys: the tailored design method. 4th edition. ed. p.351-396
19. Whitworth JM, Walls AW, Wassell RW. Crowns and extra-coronal restorations: endodontic considerations: the pulp, the root-treated tooth and the crown. *Brit Dent J* 2002;**192**:315-20-27.
20. Hu J, Zhu Q. Effect of immediate dentin sealing on preventive treatment for postcementation hypersensitivity. *Int J Prosthodont* 2010;**23**:49-52.
21. Danesteh R, Ahmad B. General dentists' knowledge about postcementation hypersensitivity in fixed restoration in Kermanshah. *GMP Review* 2015;**18**:559-564.
22. Christensen GJ. Has tooth structure been replaced? *J Am Dent Assoc* 2002;**133**:103-105.
23. Christensen GJ. Resin cements and postoperative sensitivity. *J Am Dent Assoc* 2000;**131**:1197-1199.
24. Blatz MB, Mante FK, Saleh N, Atlas AM, Mannan S, Ozer F. Postoperative tooth sensitivity with a new self-adhesive resin cement--a randomized clinical trial. *Clin Oral Investig* 2013;**17**:793-798.
25. Shetty RM, Bhat S, Mehta D, Srivatsa G, Shetty YB. Comparative analysis of postcementation hypersensitivity with glass ionomer cement and a resin cement: an in vivo study. *J Contemp Dent Practice* 2012;**13**:327-31.
26. Jefferies SR, Pameijer CH, Appleby D, Boston D, Loof J, Glantz PO. One year clinical performance and post-operative sensitivity of a bioactive dental luting cement--a prospective clinical study. *Swed Dent J* 2009;**33**:193-199.
27. Saad Del D, Atta O, El-Mowafy O. The postoperative sensitivity of fixed partial dentures cemented with self-adhesive resin cements: a clinical study. *J Am Dent Assoc* 2010;**141**:1459-1466.
28. Ho AYJ, Crawford F, Newton J, Clarkson J. The effect of advance telephone prompting in a survey of general dental practitioners in scotland: a randomised controlled trial. *Community Dent Health* 2007;**24**:233-237.
29. Leece P, Bhandari M, Sprague S, Swiontkowski MF, Schemitsch EH, Tornetta P, Devereaux PJ, Guyatt GH. Internet versus mailed questionnaires: a controlled comparison (2). *J Med Internet Res* 2004;**6**:e39.
30. Raziano DB, Jayadevappa R, Valenzula D, Weiner M, Lavizzo-Mourey R. E-mail versus conventional postal mail survey of geriatric chiefs. *Gerontologist* 2001;**41**:799-804.
31. McMahon SR, Iwamoto M, Massoudi MS, Yusuf HR, Stevenson JM, David F, Chu SY, Pickering LK. Comparison of e-mail, fax, and postal surveys of pediatricians. *Pediatrics* 2003;**111**:e299-303.
32. Asch DA, Jedrziewski MK, Christakis NA. Response rates to mail surveys published in medical journals. *J Clin Epidemiol* 1997;**50**:1129-1136.
33. Almeida OD, Jr. Current state of office laparoscopic surgery. *J Am Assoc Gynecol Laparosc* 2000;**7**:545-546.
34. Matarasso A, Elkwood A, Rankin M, Elkowitz M. National plastic surgery survey: face lift techniques and complications. *J Plast Reconstr Aesthet Sur* 2000;**106**:1185-1196.
35. Horner K, Shearer AC, Rushton VE, Czajka J. Use of 'rapid' processing techniques by a sample of British dentists. *Dentomaxillofac Radiol* 1993;**22**:145-148.
36. McCarthy GM, MacDonald JK. Nonresponse bias in a national study of dentists' infection control practices and attitudes related to HIV. *Community Dent Oral Epidemiol* 1997;**25**:319-323.
37. Barclay S, Todd C, Finlay I, Grande G, Wyatt P. Not another questionnaire! Maximizing the response rate, predicting non-response and assessing non-response bias in postal questionnaire studies of GPs. *Family Practice* 2002;**19**:105-111.