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REVIEW ARTICLE

A 50-year audit of published peer-reviewed literature on pit and fissure sealants, 1962–2011

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Abstract

Objective. Pit and fissure sealants have been used for many decades to prevent the initiation of caries on susceptible tooth surfaces. The purpose of this study was to analyze the peer-reviewed published scientific literature on pit and fissure sealants over the last 50 years. ***Materials and methods.*** On the PubMed database, all publications on pit and fissure sealants from 1962–2011 were extracted using the search phrase [(pit OR fissure) AND (sealant OR sealants OR adhesive)]. Details of all retrievals were individually entered into SPSS for analysis. ***Results.*** A total of 2829 publications were found. The mean number of authors was 2.73 ± 1.90 (range = 1–23). Although single-authorship was the modal group with 32.1%, it had a sustained decrease from 75.0% for 1962–1971 to 17.6% for 2002–2011. On the contrary, publications with three or more authors increased from 8.3% to 47.3% during the same period. Human studies accounted for 88.6% and clinical trial was 11.9%, followed by reviews at 10.2% and randomized controlled trials at 6.9%. English was the language of reporting for 82.0% of the studies. ***Conclusion.*** It is anticipated that future research on pit and fissure sealants will focus on newer and more effective materials.

Key Words: *dental, sealants, prevention*

Introduction

The term 'pit and fissure sealant' is used to describe a chemically-active liquid material that is introduced into the occlusal pits and fissures of caries-susceptible teeth that, after application, either cures chemically (autopolymerizing) or is cured with a visible light source (light-cured), thus forming a micromechanically bonded protective layer that prevents the invasion of caries-producing bacteria and simultaneously cuts off the access of surviving caries-producing bacteria from their source of nutrients [1]. Pit and fissure sealants were introduced in the 1960s [2–4]. Buonocore's [5] publication of 1955 was the commencement of the acid-etch technique in dentistry and the technique of sealing pits and fissures to prevent caries was the first clinical manifestation of the acid etch technique [1].

In 1966, Roydhouse [3] reported on the commercial production of a restorative material 'Addent'. This material was the product of their research commenced in 1960 and aimed at developing a restorative material that could become an integral part of the tooth. Earlier efforts from other researchers involved attempts to seal the pits and fissures of teeth with red copper cement and chemical agents such as silver nitrate, zinc chloride and potassium ferrocyanide [6]. Also, Hyatt [7], in 1923, reported a prophylactic approach which involved the preparation of cavities in sound teeth and subsequently filling them with restorative materials. Although this method (described as prophylactic odontotomy) was criticized for drilling sound teeth and leaving poor marginal sealing quality [3], it remained in practice for more than 55 years [8].

Fissure sealants are used on occlusal tooth surfaces for protecting pits and fissures from dental caries. Sealants prevent the growth of bacteria that promote decay in pits and fissures of the teeth [9,10]. Currently there are two types of pit and fissure sealants available: resin based and glass ionomer cements. The resin based sealants are further divided into generations according to their mechanism for polymerization or content. The development of sealants has progressed from the first generation sealants which were activated

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Table I. The distribution of the number of authors in 10-yearly intervals.

			Number of authors							
			One	Two	Three	Four	Five	Six or more		
S/No	Years	Number of publications*	*n* (%)	*n* (%)	*n* (%)	*n* (%)	*n* (%)	*n* (%)	Range	Mean ± SD
1	1962–1971	12	9 (75.0)	2 (16.7)	0 (0.0)	0 (0.0)	1 (8.3)	0 (0.0)	1–5	1.50 ± 1.17
2	1972–1981	630	290 (46.0)	154 (24.4)	109 (17.3)	52 (8.3)	14 (2.2)	11 (1.8)	1–15	2.06 ± 1.45
3	1982–1991	729	288 (39.5)	170 (23.3)	147 (20.2)	62 (8.5)	34 (4.7)	28 (3.8)	1–11	2.33 ± 1.62
4	1992–2001	614	162 (26.4)	122 (19.9)	144 (23.5)	107 (17.4)	43 (7.0)	36 (5.9)	1–16	2.89 ± 1.96
5	2002–2011	769	135 (17.6)	120 (15.6)	145 (18.9)	151 (19.6)	105 (13.7)	113 (14.7)	1–23	3.56 ± 2.11
	Total	2754	884 (32.1)	568 (20.6)	545 (19.8)	372 (13.5)	197 (7.2)	188 (6.8)	1–23	2.73 ± 1.90

*Includes only the publications with listed authors.

with ultraviolet light, through the second and third generations of autopolymerized and visible-light activated sealants, to the fourth generation containing fluoride [11–13]. First generation sealants are no longer marketed.

Commercially-available sealants differ in whether they are free of inert fillers or are semi-filled and whether they are clear, tinted or opaque [11]. Fluoride-containing resin-based sealants have been introduced [12,13]. The second type of sealant material, the glass ionomer cements, was introduced in 1974 by McLean and Wilson [14]. Glass ionomer cements contain fluoride and prevent caries through their fluoride release [13,15,16].

Yengopal et al. [10] conducted a quantitative systematic review to appraise the evidence on the caries-preventive effect of glass ionomer cement (GIC) in relation to resin-based fissure sealants and found no evidence that either material was superior to the other in the prevention of dental caries. They, therefore, concluded that both materials appear equally suitable for clinical application as a fissure sealant material.

The wealth of literature over more than 40 years, combined with systematic reviews of recent studies, shows that pit and fissure sealant is an effective treatment for preventing the initiation of caries on sound, susceptible pit and fissure surfaces in children and adolescents [1]. However, the aim of this study

Table II. The types of studies conducted for fissure sealants.

			Type of study#									
			Human	Other animals	Case Report	Clinical Trial	Editorial	*In-vitro*	Meta-analysis	Randomized Controlled trial	Review	Systematic Review
S/No	Years	Number of publications*	*n* (%)	*n* (%)	*n* (%)	*n* (%)	*n* (%)	*n* (%)	*n* (%)	*n* (%)	*n* (%)	*n* (%)
1	1962–1966	3	3 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	2 (66.7)	0 (0.0)	0 (0.0)	1 (33.3)	0 (0.0)
2	1967–1971	10	4 (40.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
3	1972–1976	336	229 (68.2)	1 (0.3)	4 (1.2)	24 (7.1)	1 (0.3)	14 (4.2)	0 (0.0)	1 (0.3)	20 (6.0)	0 (0.0)
4	1977–1981	308	239 (77.6)	12 (3.9)	3 (1.0)	26 (8.4)	1 (0.3)	12 (3.9)	0 (0.0)	3 (1.0)	26 (8.4)	0 (0.0)
5	1982–1986	340	317 (93.2)	10 (2.9)	5 (1.5)	9 (2.6)	1 (0.3)	3 (0.9)	0 (0.0)	1 (0.3)	27 (7.9)	2 (0.6)
6	1987–1991	420	386 (91.9)	9 (2.1)	4 (1.0)	30 (7.1)	1 (0.2)	5 (1.2)	0 (0.0)	9 (2.1)	48 (11.4)	2 (0.5)
7	1992–1996	291	275 (94.5)	11 (3.8)	10 (3.4)	37 (12.7)	5 (1.7)	4 (1.4)	1 (0.3)	19 (6.5)	39 (13.4)	6 (2.1)
8	1997–2001	336	313 (93.2)	14 (4.2)	3 (0.9)	43 (12.8)	1 (0.3)	7 (2.1)	4 (1.2)	28 (8.3)	44 (13.1)	18 (5.4)
9	2001–2006	362	340 (93.9)	19 (5.2)	10 (2.8)	73 (20.2)	4 (1.1)	11 (3.0)	5 (1.4)	54 (14.9)	38 (10.5)	22 (6.1)
10	2006–2011	423	401 (94.8)	11 (2.6)	12 (2.8)	94 (22.2)	6 (1.4)	16 (3.8)	6 (1.4)	79 (18.7)	46 (10.9)	33 (7.8)
	Total	2829	2507 (88.6)	87 (3.1)	51 (1.8)	336 (11.9)	20 (0.7)	74 (2.6)	16 (0.6)	194 (6.9)	289 (10.2)	83 (2.9)

*The numbers for the types of study may not sum up to the total number of publications because some categories of publications (e.g. Guidelines) were not included in the table. Also, 'Human' and 'Other animals' may not sum up to the total number of publications because of publications that do not fall into any of these groups.
#The characteristics of the types of studies are defined in the scope notes of the PubMed database http://www.nlm.nih.gov.ezp-prod1.hul.harvard.edu/mesh/pubtypes.html (Accessed February 19, 2013).

Table III. The distribution of countries where the studies were conducted.

Country	No. of publications*	%	Ranking
USA	585	31.9	1
UK	143	7.8	2
Germany	133	7.2	3
Brazil	96	5.2	4
Italy	69	3.8	5
Australia	58	3.2	6
Japan	58	3.2	6
Sweden	44	2.4	8
Turkey	44	2.4	8
Canada	41	2.2	10
China	38	2.1	11
France	38	2.1	11
Netherlands	37	2.0	13
Spain	37	2.0	13
Finland	33	1.8	15
India	32	1.7	16
Denmark	29	1.6	17
Greece	25	1.4	18
Poland	23	1.3	19
Switzerland	22	1.2	20
Israel	21	1.1	21
South Africa	18	1.0	22
Russia	16	0.9	23
Thailand	16	0.9	23
Other Countries (39 with less than 15 publications each)	175	9.6	
Total	1831	100.0	

*List includes only the publications with identifiable countries of research.

was to analyze the peer-reviewed published scientific literature on pit and fissure sealants over the last 50 years (1962–2011) and provide a basis for predicting the possible future developments in sealant research.

Materials and methods

This study used the PubMed database, a resource developed and maintained by the National Center for Biotechnology Information at the US National Library of Medicine. PubMed indexes the largest range of peer-reviewed journals in the world and the citations and abstracts include the fields of biomedicine and health, covering portions of the life sciences, behavioral sciences, chemical sciences and bioengineering (http://www.ncbi.nlm.nih.gov). All publications on pit and fissure sealants up to December 31, 2011 were extracted with the search phrase [(pit OR fissure) AND (sealant OR sealants OR adhesive)] and using the publication dates filter. Data cleaning was done by reviewing each extracted reference (title, author details and abstract) to eliminate any anomalous publications (not related to dentistry). All references from the finalized set were individually entered into SPSS software (SPSS Inc, 1989–2007, Version 16, Chicago, IL) for statistical analysis.

Results

Number of publications

A total of 2829 publications on pit and fissure sealants were found using the criteria outlined in the methodology (Table I).

Number of authors

There were 2754 publications with listed authors. The mean number of authors was 2.73 ± 1.90 (range = 1–23). Single-authorship was the modal group, with 884 (32.1%). There was a sustained transition from single-authorship to multi-authored publications with a decrease in single-authorship from 75.0% for 1962–1971 to 17.6% during the period 2002–2011. On the contrary, the number of publications with three or more authors increased from 8.3% (one of 12 publications) to 47.3% for 2002–2011 (1302 of

Table IV. The distribution of the languages of publication.

Language of publication	No. of publications	%	Ranking
English	2319	82.0	1
German	129	4.6	2
Italian	60	2.1	3
French	55	1.9	4
Japanese	47	1.7	5
Spanish	42	1.5	6
Polish	31	1.0	7
Portuguese	25	0.9	8
Chinese	22	0.8	9
Russian	19	0.7	10
Dutch	15	0.5	11
Danish	13	0.5	12
Norwegian	10	0.4	13
Croatian	10	0.4	13
Modern Greek	9	0.3	15
Hungarian	8	0.3	16
Other languages*	15	0.5	
Total	2829	100.0	

*Includes Hebrew, Swedish, Bulgarian, Czech, Korean, Serbian, Lithuanian, Slovenian, Thai, Turkish and Romanian languages.

Table V. Guidelines on pit and fissure sealants.

S/No	Theme	Source/organization	Reference
1	Use of Sealants including the management of the stained fissure in first permanent molars	British Society of Paediatric Dentistry	Smallridge [17]
2	Use of Fluorides	Ministry of Health, New Zealand	Coop et al. [18]
3	School-based Sealant Programs	Center for Oral Disease Control and Prevention, USA	Gooch et al. [19]
4	Policy on third-party reimbursement	American Academy of Pediatric Dentistry	American Academy on Pediatric Dentistry [20]
5	Pediatric Restorative Dentistry	American Academy of Pediatric Dentistry	American Academy of Pediatric Dentistry [21]
6	Clinical Pediatric Restorative Dentistry	American Academy of Pediatric Dentistry	American Academy of Pediatric Dentistry [22]
7	Use of Pit and Fissure Sealants	EAPD European Academy of Paediatric Dentistry	Welbury et al. [23]
8	Direct placement of restorative materials in posterior teeth	Ministry of Health, New Zealand	Lyons [24]
9	UK National Clinical Guidelines in Paediatric Dentistry	UK, Royal College of Surgeons	Smallridge [25]
10	Fissure Sealants in Paediatric Dentistry	British Society of Paediatric Dentistry	Nunn et al. [26]
11	Prevention of Dental Caries	The Canadian Task Force on the	Lewis & Ismail [27]
12	Recommendations on Sealants Use	The Association of State and Territorial Dental Directors, the New York State Health Department, The Ohio Department of Health and School of Public Health, University of Albany, State University of New York	The Association of State and Territorial Dental Directors, the New York [28]
13	Fissure Sealants	British Society of Paediatric Dentistry	Murray and Nunn [29]
14	Dental Caries	School of Dentistry, University of California, San Francisco	Greene et al. [30]
15	Cost effectiveness of sealants in private practice and standards for use in prepaid dental care	Council on Dental Research	Council on Dental Research [31]

2754 publications) (Table I). There was significant correlation between the years and the number of authors (Spearman's rho = 0.352, $p < 0.001$).

Types of studies

Human studies accounted for 2750 (88.6%). The most common type of study was clinical trial at 336 (11.9%), followed by 289 reviews (10.2%) and 194 randomized controlled trials (6.9%). There was a steady percentage increase in the number of published randomized controlled trials from 6.5% in 1992–1996 to 18.7% in the period 2007–2011. No systematic reviews were reported before 1982 and they constituted only 0.5% (two of 340) from 1982–1986. These became more common from 1997. The distribution according to study types is presented in Table II.

Countries where studies were conducted

The majority of the studies were conducted in the US (31.9%), UK (7.8%) and Germany (7.2%). The contributions from Asian countries included Brazil (5.2%), Japan (3.2%), China (2.1%), India (1.7%) and Thailand (0.9%). South Africa (18, 1.0%) and Zimbabwe (with four publications, grouped with other countries) were the only African countries that contributed reports (Table III).

Languages of publication

The publications were in 27 languages. The major language of publication was English, with 2319 (82.0%). German contributed 129 (4.6%), Italian 60 (2.1%), French 55 (1.9%), Japanese 47 (1.7%), Spanish 42 (1.5%) and Polish 31 (1.0%). All other languages contributed less than 1% (Table IV). Guidelines on pit and fissure sealants are presented in Table V.

Discussion

Over the last 50 years, a lot of research, both human and animal studies, had been conducted on pit and fissure sealants by several researchers focusing on the key issues of sealant use, methodology and

advancements in materials [1,10,16,32,33]. It is also important to note that, since the first meta-analysis of clinical trials was reported by Llodra et al. [34] in 1993, numerous reports have provided increasing scientific evidence of the effectiveness of pit and fissure sealants for children, placing the procedure among the most efficacious preventive measures in dentistry [1,9,10,12,16,19,33]. We have therefore set out to analyze these studies and encapsulate their main characteristics.

The transition from single-authorship to multi-authored publications is in line with the global trend in dental research. Madan et al. [35] examined the last 30 years of peer-reviewed published dental literature in both Australia and India and found a rapid transition in Australia from single author publications to multi-author, with single-author publications falling from ~ 70% to 20% [35]. In India, publications with four or more authors made up a far higher proportion (~ 35%) much earlier than in Australia.

The introduction of systematic reviews from 1982 and the increasing popularity is not peculiar to studies on sealants and is in agreement with the general trends in dental research. This trend was promoted and is being assisted by such bodies as the Cochrane Collaboration [36]. It is gratifying that clinical trials, randomized controlled trials and reviews (including systematic reviews) presently form the majority of peer-reviewed publications on sealants. This may be a reflection of the continuous search for new improved materials and their introduction into the clinical setting. The continuity of animal studies on sealants is also in agreement with these developments. Although editorials contribute less than 1% of total publications, they attest to the importance and continuous relevance of pit and fissure sealants.

The distribution of the countries where studies were conducted appears to be highly skewed with the US (31.9%) and European countries dominating. Fewer studies were conducted in Asia and other continents. Several factors such as tooth-eruption times, diet, temperature and cultural practices may affect the clinical application and retention of sealants [37] and may make the direct extrapolation of research findings to other settings inappropriate in some peculiar situations. Thus, it is important for research output to represent the global situation and thus capture whatever variations or peculiarities that may exist internationally.

English language accounted for more than 80% of the publications. This observation probably explains why a number of universities in non-English speaking countries, especially in Europe and Asia, now encourage studies in English language. This policy, usually aimed at increasing international competitiveness [38], may also be beneficial in some research areas, including pit and fissure sealants.

Conclusions

Based on the results of this study, the following conclusions can be made:

(1) Research on pit and fissure sealants will continue to grow in the years to come, with particular focus on newer and more effective materials and methods.
(2) Human studies will continue to dominate and clinical trials, randomized controlled trials and reviews (including systematic) will continue to dominate the type of research that will be undertaken in the immediate future.
(3) It is desirable for those conducting research on sealants to have a working knowledge of English, the language of reporting for more than 80% of the studies published in the last 50 years.

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References

[1] Simonsen RJ, Neal RC. A review of the clinical application and performance of pit and fissure sealants. Aust Dent J 2011; 56:45–58.
[2] Cueto EI, Buonocore MG. Adhesive sealing of pits and fissures for caries prevention. J Dent Res 1965;44:137.
[3] Roydhouse RH. Progress in the development of adhesive restorations. J Canad D Assoc 1966;32:81–7.
[4] Roydhouse RH. Prevention of occlusal fissure caries by use of a sealant: a pilot study. ASDC J Dent Child 1968;35:253–62.
[5] Buonocore MG. A simple method of increasing the adhesion of acrylic filling materials to enamel surfaces. J Dent Res 1955; 34:849–53.
[6] Gwinnett AJ, Buonocore MG. Adhesives and caries prevention. A preliminary report. Br Dent J 1965;119:77–80.
[7] Hyatt TP. Prophylactic odontotomy: the cutting into the tooth for the prevention of disease. Dent Cosmos 1923;65:234–41.
[8] Simonsen RJ. Preventive resin restorations (I). (Report 1594). Quintessence Int Dent Dig 1978;9:69–76.
[9] Ahovuo-Saloranta A, Hiiri A, Nordblad A, Mäkelä M, Worthington HV. Pit and fissure sealants for preventing dental decay in the permanent teeth of children and adolescents. Cochrane Database Syst Rev 2008;4:CD001830.
[10] Yengopal V, Mickenautsch S, Bezerra AC, Leal SC. Caries-preventive effect of glass ionomer and resin-based fissure sealants on permanent teeth: a meta analysis. J Oral Sci 2009;51:373–82.
[11] Ripa LW. Sealants revisted: an update of the effectiveness of pit-and-fissure sealants. Caries Res 1993;27:77–82.
[12] Carlsson Å, Petersson M, Twetman S. 2-year clinical performance of a fluoride-containing fissure sealant in young schoolchildren at caries risk. Am J Dent 1997;10:115–19.
[13] Zhou SL, Zhou J, Watanabe S, Watanabe K, Wen LY, Xuan K. *In vitro* study of the effects of fluoride-releasing dental materials on remineralization in an enamel erosion model. J Dent 2012;40:255–63.
[14] McLean JW, Wilson AD. Fissure sealing and filling with an adhesive glass-ionomer cement. Br Dent J 1974;136:269–76.
[15] Bayrak S, Tunc ES, Aksoy A, Ertas E, Guvenc D, Ozer S. Fluoride release and recharge from different materials used as fissure sealants. Eur J Dent 2010;4:245–50.

[16] Mickenautsch S, Mount G, Yengopal V. Therapeutic effect of glass-ionomers: an overview of evidence. Aust Dent J 2011;56: 10–15.
[17] Smallridge J. UK National Clinical Guidelines in Paediatric Dentistry. Management of the stained fissure in the first permanent molar. Int J Paediatr Dent 2000;10:79–83.
[18] Coop C, Fitzgerald AC, Whyman RA, Lethaby A, Beatson E, Caddie C, et al. Summary of guidance for the use of fluorides. N Z Dent J 2009;105:135–7.
[19] Gooch BF, Griffin SO, Gray SK, Kohn WG, Rozier RG, Siegal M, et al. Centers for Disease Control and Prevention. Preventing dental caries through school-based sealant programs: updated recommendations and reviews of evidence. J Am Dent Assoc 2009;140:1356–65.
[20] American Academy on Pediatric Dentistry Clinical Affairs Committee; American Academy on Pediatric Dentistry Council on Clinical Affairs. Policy on third-party reimbursement of fees related to dental sealants. Pediatr Dent 2008–2009;30:78.
[21] American Academy of Pediatric Dentistry Clinical Affairs Committee–Restorative Dentistry Subcommittee; American Academy of Pediatric Dentistry Council on Clinical Affairs. Guideline on pediatric restorative dentistry. Pediatr Dent 2005–2006;27:122–9.
[22] American Academy of Pediatric Dentistry. Clinical guideline on pediatric restorative dentistry. Pediatr Dent 2004;26: 106–14.
[23] Welbury R, Raadal M, Lygidakis NA. Academy of Paediatric Dentistry. EAPD guidelines for the use of pit and fissure sealants. Eur J Paediatr Dent 2004;5:179–84.
[24] Lyons K. Direct placement restorative materials for use in posterior teeth: the current options. N Z Dent J 2003;99:10–15.
[25] Smallridge J; British Society of Paediatric Dentistry. Guideline for the use of fissure sealants including management of the stained fissure in first permanent molars. Int J Paediatr Dent 2010;20:3.
[26] Nunn JH, Murray JJ, Smallridge J; BSPD. British Society of Paediatric Dentistry: a policy document on fissure sealants in paediatric dentistry. Int J Paediatric Dent 2000;10:174–7.
[27] Lewis DW, Ismail AI. CMAJ. Periodic health examination, 1995 update: 2. Prevention of dental caries. The Canadian Task Force on the Periodic Health Examination. CMAJ 1995; 152:836–46.
[28] Workshop on guidelines for sealant use: recommendations. The Association of State and Territorial Dental Directors, the New York State Health Department, the Ohio Department of Health and the School of Public Health, University of Albany, State University of New York. J Public Health Dent 1995;55: 263–73.
[29] Murray J, Nunn J. British Society of Paediatric Dentistry: a policy document on fissure sealants. Int J Paediatr Dent 1993;3:99–100.
[30] Greene JC, Louie R, Wycoff SJ. Preventive dentistry. I. Dental caries. JAMA 1989;262:3459–63.
[31] Council on Dental Research. Cost-effectiveness of sealants in private practice and standards for use in prepaid dental care. J Am Dent Assoc 1985;110:103–7.
[32] Feigal RJ. The use of pit and fissure sealants. Pediatr Dent 2002;24:415–22.
[33] Kühnisch J, Mansmann U, Heinrich-Weltzien R, Hickel R. Longevity of materials for pit and fissure sealing - Results from a meta-analysis. Dent Mater 2012;28:298–303.
[34] Llodra JC, Bravo M, Delgado Rodriguez M, Baca P, Galvez R. Factors influencing the effectiveness of sealants a meta analysis. Com Dent Oral Epidemiol 1993;21:261–8.
[35] Madan C, Kruger E, Tenant M. 30 years of dental research in Australia and India. A comparative analysis of published peer review literature. Indian J Dent Res 2012;23:293–4.
[36] The Cochrane Collaboration. Cochrane reviews. Available online at http://www.cochrane.org/cochrane-reviews.accessed 16 November 2012.
[37] Postma TC, van Wyk PJ, Ayo-Yusuf OA. Empirical support for a fissure sealant placement timeframe protocol for black South Africans. SADJ 2008;63:344–6.
[38] The Observatory on Borderless Higher Education. The growth of English-medium instruction in East Asia: the key to competitiveness? 2007. Available online at www.obhe.ac.uk/documents/download?id=195.accessed 18 November 2012.