Adhesive cementation is playing an ever increasing role in day to day dentistry. The continued development of modern, highly esthetic and minimally invasive treatment methods has in fact only been possible due to adhesive cementation.

New products come and go – unfortunately often as regularly as the International Dental Show in Cologne. It is not rare to see products modified or even withdrawn from the market before meaningful clinical data on their long-term effectiveness is available. Yet, the long-term clinical performance of an adhesive resin composite should surely be one of the most important factors when selecting a dental material.

Although materials science investigations may give some indication of the likely fitness of an adhesive luting composite in the clinical setting, only the (positive) results of clinical studies can give patients and dental professionals the real assurance they need. Adequate self-curing is another aspect of luting composites that should not be overlooked. Self-curing constitutes the key to success for resin cements applied in areas where adequate light-polymerisation can be problematic e.g. in root canals, deep proximal areas, metal-ceramic restorations or under opaque ceramic frameworks.

The results of the clinical studies performed on Multilink® Automix are presented in this brochure and impressively demonstrate the clinical effectiveness of this advanced adhesive luting composite. Even when compared directly with Panavia 21 – the previous standard in dual-curing adhesive cement at our clinic at the Christian-Albrechts-University in Kiel – Multilink Automix produced comparable results in the cementation of zirconium oxide but with improved handling (see Sasse et al. 2013).

Wishing you every success with all your adhesive cementation work!

Prof. Dr Matthias Kern
Title of the study: Clinical evaluation of chairside lithium disilicate CAD/CAM crowns – 4-year report

Place of the study: University of Michigan, Ann Arbor, MI, USA
Time: 2007 – 2011
Study coordinator: J. Fasbinder

Method:
Twenty-three IPS e.max® lithium disilicate crowns (premolars and molars) were fabricated chairside with a CEREC® 3D milling unit and adhesively cemented using Multilink® Automix.

Results:
One week postoperatively, the participants described 13.0 percent (3/23) of the crowns as slightly sensitive. However, all participants reported not having symptoms by the third week after treatment. No patient required treatment for sensitivity.

Twenty-two of 23 cases could be evaluated at the 36-month recall, 21 at the 48-month recall. One crown debonded after 36 months and was rebonded using Multilink Automix.

48-month results:
• Colour match: 20/21 alpha, 1/21 bravo
• Margin discoloration: 16/21 alpha, 3/21 bravo-1, 2 charlie-1
• Margin adaptation: 6/21 alpha-1, 13/21 alpha-2, 2 bravo-1
• Caries: 21/21 alpha

Summary:
All the 23 crowns seated with Multilink Automix were clinically acceptable after 48 months; one case of debonding was reported for Multilink Automix after 36 months. This crown was rebonded without incident using Multilink Automix.

Conclusion:
IPS e.max CAD crowns cemented with Multilink Automix proved their clinical efficiency over a period of 3 years; no loss of a restoration occurred.

Reference:
(Fasbinder, 2010 + 2011)
Title of the study: Clinical performance of CAD/CAM-fabricated lithium disilicate restorations

Place of the study: Ludwig Maximilian University Munich, Munich, Germany
Time: 2007 – 2011
Study coordinator: F. Beuer

Method:
Fifteen fully anatomical and partially reduced IPS e.max® CAD (lithium disilicate) restorations were cemented using Multilink® Automix.

Results:
After an average observation period of 4 years, there have been no reported failures of the restorations. In addition, there were no instances of hypersensitivity and no incidences of debonding.

Summary:
- 100% survival after 4 years
- No hypersensitivity in vital teeth

Conclusion:
Multilink Automix proved its clinical efficiency in combination with IPS e.max CAD over a period of 4 years.

Reference:
(Richter, 2009; Beuer 2011)
Title of the study: **In-vivo marginal seal of Multilink®: IPS Empress® 2 all-ceramic crowns vs. conventional porcelain-veneered crowns**

Place of the study: University of Graz, Graz, Austria


Study coordinator: G. Arnetzl

Method:
Prospective clinical study with 28 patients over a period of 48 months. Fifty-four crowns (27 made of Empress 2 and 27 made of IPS d.SIGN® on Porta GeoTi), as well as 6 inlays, 5 onlays, 6 adhesive bridges and 3 post&core build-ups were adhesively cemented using Multilink®.

Results:
For only 2 (2.7%) of 74 restorations, postoperative sensitivities were noted at baseline (one inlay with the cavity area near the pulp, one onlay with postoperative sensitivity to pressure). Both sensitivity episodes did not last longer than 36 hours.

In contrast to other self-etching primers, no desquamation of the epithelial tissue was noted.

No tissue reaction of the gingiva in the form of reddening, bleeding, oedema, or whitish surface burns occurred.

No loss of retention was noted after 48 months.

- Recall 6 months: 50 restorations: No sensitivities, no loss of retention, no marginal discoloration
- Recall 18 months: 50 restorations: No sensitivities, no loss of retention, no marginal discoloration
- Recall 48 months: 50 restorations: No sensitivities, no loss of retention, one marginal discoloration (patient with known regular red wine consumption)

Summary:
In only 2 (2.7%) of 74 restorations, postoperative sensitivities were noted for a maximum of 36 hours. Fifty of initially 74 restorations were analysed at the recall after 48 months: no loss of retention was observed. Only in one of 50 cases a slight margin discoloration occurred in a patient with known regular consumption of red wine.

Conclusion:
Multilink® Automix has proven reliable over an observation period of 48 months, with no loss of retention.

Reference:
(Salz and Arnetzl, 2007)
Title of the study: Clinical performance and fit of a milled ceramic crown system

Place of the study: Boston University, Boston, MA, USA
Study coordinator: D. Nathanson

Method:
Thirty-one IPS e.max® CAD LS2 crowns (23 anterior crowns, 8 posterior crowns) were placed in 14 patients. They were veneered with IPS e.max® Ceram and cemented using Multilink® or Multilink® Automix. Marginal accuracy and clinical performance were assessed.

Results:
Mean in-vitro marginal fit was 67.92 (+/-25.2) µm. Clinical fit was ranked Alpha for all restorations. Three anterior single crowns required re-fabrication for improved colour. Seventeen restorations (55% of all) were evaluated at 2–3 years. One (posterior) restoration fractured after requiring RCT through the crown after 12 months.

Summary:
After an observation period of up to 3 years, only one crown fractured after endodontic treatment through the crown. No other adverse findings were noted throughout the recall process.

Reference:
(Nathanson, 2008)
Title of the study: CAD/CAM single retainer zirconia-ceramic resin-bonded fixed dental prostheses: clinical outcome after 5 years

Place of the study: University of Kiel, Kiel, Germany
Time: 2006 – 2013
Study coordinator: M. Kern

Method:
Fourteen anterior zirconia cantilever adhesive bridges were inserted using Multilink® Automix with Metal/Zirconia primer.

Results:
After 20.8 months one debonding occurred with Multilink caused by a traumatic impact. The restoration was rebonded successfully with the original bonding system. If these debondings were considered as (partial) technical failure the overall five-year survival rate calculated with SPSS Software according to Kaplan–Meier was 92.9%. If only the final loss of a bridge was considered as failure and therefore considering rebonded bridge as success, the five-year survival rate increased to 100%.

Summary:
After 20.8 months one debonding occurred with Multilink Automix caused by a traumatic impact. With regard to the total of 14 inserted bridges, the survival rate can be considered as 92.9%. The restoration was rebonded using Multilink Automix and is still in situ after five years.

Reference:
(Sasse 2012, Sasse and Kern 2013)
Title of the study: Prospective clinical evaluation of all-ceramic crowns at 36 months

Place of the study: University of North Carolina, Chapel Hill, NC, USA
Time: Observation period of 36 months
Study coordinator: D. Felton and L. Cooper

Method:
Twenty-three patients received 33 posterior all-ceramic lithium disilicate single unit crowns (IPS Eris / IPS Empress® 2, Ivoclar Vivadent), bonded within 3 weeks of tooth preparation with Multilink®.

Results:
Twenty-nine of 33 teeth (87.8%) exhibited no symptoms or radiographic evidence of pulpal pathology; one tooth required root canal treatment (RCT) prior to crown delivery, three required RCT after crown cementation. No other experimental or control teeth exhibited any postoperative sensitivity nor evidence of peri-apical pathology at the 12-month interval. There was a loss of proximal contact on 5% of the crowns.

Conclusion:
Lithium disilicate all-ceramic crowns, bonded to prepared posterior teeth with Multilink composite resin cement, clinically perform well with minimal pulpal problems for full-coverage restorations at 36 months.

Reference:
(Felton 2010)
Title of the study: Three-unit CAD-CAM-fabricated lithium disilicate bridges after a mean observation period of 46 months.

Place of the study: Multi-center study in Berlin, Buchholz i. d. Nordheide, Zwickau and Aachen, Germany, under the direction of the RWTH Aachen, Germany


Study coordinator: S. Reich, L. Endres, C. Weber, K. Wiedhahn, P. Neumann, O. Schneider, N. Rafai, S. Wolfart

Method:
A total of 38 three-unit bridges up to max. the second premolar as the abutment tooth were fabricated of IPS e.max® CAD LT and placed in 33 patients. Fifteen bridges were layered with IPS e.max Ceram after cut-back. Cementation was performed with Multilink® Automix.

Results:
After 48 months, 32 bridges were evaluated. For patients who obtained more than one bridge, only one bridge was selected at random for the evaluation. One female patient did not appear for the recall because she had moved away. Two bridges were rated as failures. One of them fractured in the connector area and the other had to be removed due to unexplained, continuous pain. Two minor cases of repairable chipping were observed after 3 years. Furthermore, 3 endodontic complications occurred in 2 bridges after 1.3 and 1.6 years (one of these bridges was removed after 3 years, as described above, due to pain). The survival rate according to Kaplan-Meier was 93%.

Summary:
Only one fracture of the restorations seated thus far was reported after a mean observation period of 46 years. This fracture occurred within one year after placement and was caused by the failure to observe the recommended connector dimensions.

Conclusion:
Bridges made of IPS e.max CAD luted with Multilink Automix up to the premolars proved their clinical efficiency over a period of 4 years.

Reference:
(Richter et al., 2009; Reich et al., 2014)
Title of the study: Multilink® Automix – Four-Year Clinical Performance

Place of the study: The Dental Advisor
Time: 2010 – 2014
Study coordinator: The Dental Advisor

Method:
Four hundred seven restorations cemented with Multilink® Automix were recalled at four years (241 full crowns, 157 inlays/onlays and 3 3-unit bridges). Multilink Automix was used to cement leucite-reinforced (201), lithium disilicate (173), zirconia (25) and resin-based (1) restorations. The evaluated restorations were in situ for 4 years (87), 3 – 4 years (119) and 2 – 3 years (107), 1 – 2 years (57) or less than one year (37). At recall, restorations were evaluated for resistance to marginal discoloration and retention on a 1-5 rating scale: 1 = poor, 2 = fair, 3 = good, 4 = very good, 5 = excellent.

Results:
Multilink Automix maintained excellent color stability in 100% of restorations placed over the four-year evaluation period (esthetics were rated 5.0). Five restorations exhibited staining or graying at the margins. The color of nearly 99% of the restorations has been stable with almost no evidence of microleakage (average rating of resistance to marginal discoloration 4.9).
Lack of sensitivity was rated excellent (5.0). No additional postoperative sensitivity was reported between years three and four.
Retention was rated excellent (4.9) with an adjusted debond rate of 2.7%. Sixteen restorations debonded during the past four years. These restorations included ten lithium disilicate restorations; four ceramic-veneered zirconia restorations, one of which was a three-unit bridge; and two leucite-reinforced restorations.

Summary:
Four hundred and seven restorations, cemented with Multilink Automix, recalled at four years. The restorations continue to exhibit excellent esthetics, excellent lack of postoperative sensitivity, very good resistance to marginal staining and excellent retention.
Clinicians feel confident about the longevity of the restorations they cement with this product. Multilink Automix received a 98% clinical performance rating.

Reference:
(The Dental Advisor 2014)
Title of the study: 8 years’ clinical behavior of adhesively luted all-ceramic single-unit restorations

Place of the study: Ivoclar Vivadent AG, Schaan/Liechtenstein
Study coordinator: R. Watzke, L. Enggist

Objective:
Evaluation of the clinical behavior of all-ceramic lithium disilicate (IPS e.max® CAD /Press) single-unit restorations luted with Multilink® Automix after a mean observation period of around 8 years.

Method:
Fifty-five single-unit restorations (IPS e.max CAD / Press) were adhesively luted with Multilink Automix. 33 crowns, 13 partial coverage crowns and 9 inlays were placed by two operators. After a mean observation time of 7.9 years in clinical function 49 restorations could be assessed by selected FDI-criteria (Hickel et al. 2010). The FDI criteria include the evaluation of esthetic (A), functional (B) and biological (C) properties. Criteria concerning the restorations’ marginal quality were semi-quantitatively evaluated as a percentage of the total margin length (SQUACE). For statistical analysis, SPSS 19.00 was used. Overall, there were 6 drop-outs. Three patients could no longer be reached. One crown fractured because the occlusal minimal thickness was not respected. Two teeth were extracted due to vertical root fracture or post-endodontic failure. Of the assessed restorations the longest period in situ was 9 years and 1 month and the shortest was 7 years and 2 months.

Results:
After almost eight years most restorations exhibited “excellent” to “good” clinical performance. 17% of the total length of all the margins showed slight discoloration (FDA grade 2) and 16% of the margins showed minor irregularities.

Summary:
After almost eight years of clinical service most restorations cemented with Multilink Automix showed an outstanding clinical performance.

Reference:
(Peschke and Watzke 2013, Enggist 2016)
Title of the study: Retrospective survival analysis of 110 lithium disilicate crowns with feather-edge marginal preparation

Place of the study: Private practice, Pordenone, Italy
Time: 2004 – 2013
Study coordinator: M. Valenti, A. Valenti

Method:
In total, 110 lithium disilicate crowns with feather-edge marginal preparation were cemented with Multilink Automix in 59 patients. The restorations were evaluated by a different clinician after up to 9 years using the California Dental Association (CDA) modified criteria. The data were analyzed using the Kaplan-Meier method.

Results:
Two crowns had failed and were replaced due to core fractures. One chipping occurred on a first molar and the ceramic surface was polished. One restoration with a fiber post debonded after 46 months.

96.1% survival rate according to Kaplan-Meier

Summary:
The overall survival probability was 96.1% up to 9 years.

Conclusion:
In this retrospective analysis up to 9 years, a low clinical failure rate was observed.

Reference:
(Valenti M, Valenti A, 2015)
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