Tomographic Evaluation of Reparative Dentin Formation after Direct Pulp Capping with Ca(OH)$_2$, MTA, Biodentine, and Dentin Bonding System in Human Teeth

Alicja Nowicka, DDS, PhD,* Grażyna Wilk, MD, PhD,† Mariusz Lipski, DDS, PhD,‡ Janusz Kolecki, MD, PhD,§ and Jadwiga Buczkowska-Radlińska, DDS, PhD*

Abstract

Introduction: New materials can increase the efficiency of pulp capping through the formation of a complete reparative dentin bridge with no toxic effects. The present study involved tomographic evaluations of reparative dentin bridge formation after direct pulp capping with calcium hydroxide, mineral trioxide aggregate (MTA), Biodentine (Septodont, Saint Maur des Fossés, France), and Single Bond Universal (3M ESPE, Seefeld, Germany) in human teeth. Methods: Forty-four caries-free, intact, human third molars scheduled for extraction were subjected to mechanical pulp exposure and assigned to 1 of 4 experimental groups depending on the pulp capping agent used: calcium hydroxide, MTA, Biodentine, or Single Bond Universal. After 6 weeks, the teeth were extracted and processed for cone-beam computed tomographic imaging and histologic examination. Tomographic data, including the density and volume of formed reparative dentin bridges, were evaluated using a scoring system. Results: The reparative dentin formed in the calcium hydroxide, MTA, and Biodentine groups was significantly superior to that formed in the Single Bond Universal group in terms of thickness and volume. The dentin bridges in the Biodentine group showed the highest average and maximum volumes. The mean density of dentin bridges was the highest in the MTA group and the lowest in the Single Bond Universal group. Conclusions: The volume of reparative dentin bridges formed after direct pulp capping is dependent on the material used. Biodentine and MTA resulted in the formation of bridges with a significantly higher average volume compared with Single Bond Universal, and cone-beam computed tomographic imaging allowed for the identification of the location of dentin bridges. (J Endod 2015;41:1234–1240)

Key Words

Biodentine, calcium hydroxide, cone-beam computed tomographic imaging, direct pulp capping, mineral trioxide aggregate, Single Bond Universal

The most visible reparative response to pulp exposure is the deposition of reparative dentin that provides odontoblasts and other pulp cells and protection against harmful stimuli (1, 2). Reparative dentin formation can be affected by the pulp capping material, the degree of mechanical injury, and inflammatory and bacterial leakage (3). Currently, none of the commercially available direct pulp capping materials fulfills all the requirements of dentists despite rapid progress in the field (4–7). Calcium hydroxide (Ca(OH)$_2$) remains the gold standard for the management of pulp exposure because of its potent antibacterial properties and its ability to stimulate reparative dentin formation and, consequently, pulp healing (2, 6, 8, 9). However, Ca(OH)$_2$ is reported to dissolve over time, and dentin bridges adjacent to the material may contain multiple tunnel defects that open into the underlying pulp (5, 10–14).

Recent studies showed that other materials and strategies may increase the efficiency of pulp capping through the formation of a complete reparative dentin bridge with no chemical toxic effects, thus providing better results than those provided by Ca(OH)$_2$ (12–15). Mineral trioxide aggregate (MTA) is characterized by improved sealing properties and a greater ability to stimulate reparative dentin formation compared with Ca(OH)$_2$; however, it has the disadvantages of difficult handling and application, a longer binding duration, and a relatively high cost (4, 5, 8, 12–14). Several attempts to improve the binding reaction of MTA by the addition of various accelerators and modifiers have been made to provide novel materials that can be effectively used for direct pulp capping (4, 13). Biodentine (Septodont, Saint Maur des Fossés, France) is a new material based on calcium silicates and has properties similar to those of Ca(OH)$_2$ and MTA; furthermore, it overcomes some limitations of the latter 2 preparations (14–16). Previous in vitro and in vivo studies confirmed that Biodentine has a positive effect on pulp cells and promotes reparative dentin formation in a manner similar to MTA (14–19).

In recent years, dentin bonding systems have also been investigated (5–7, 20, 21) as potential direct pulp capping materials because of their superior adhesion to demineralized dentin tissues. Single Bond Universal (3M ESPE, Seefeld, Germany) represents the next generation of bonding systems available to dentists, the so-called universal systems (7, 22). Application of this material on the dentin surface results in the formation of a hybrid layer, with superior chemical bonding of the monomer...
10-methacryloxydecyl dihydrogen phosphate to hydroxyapatite (23). However, the effectiveness of this system in reparative dentin formation after application to exposed pulp remains to be elucidated.

Although the histologic evaluation of dentin bridge sections is commonly accepted as the gold standard, cone-beam computed tomographic (CBCT) imaging represents an innovative and noninvasive technique that offers the possibility of studying dental tissue without the need to destroy it (24–27). In addition, 3-dimensional reconstruction of CBCT images eliminates the superimposition of surrounding structures (24).

The present study aimed to conduct tomographic evaluations of reparative dentin bridges formed after direct capping with Ca(OH)₂, MTA, Biodentine, and Single Bond Universal in human teeth to verify the null hypothesis that there is no difference in the quantity and quality of reparative dentin formation between the evaluated materials used for direct pulp capping in human teeth.

Materials and Methods

Operative Procedure

The study was conducted in accordance with the tenets of the Declaration of Helsinki. Forty-four caries-free, intact, maxillary and mandibular third molars from 21 humans aged 19–32 years (mean 26 years) scheduled for extraction for orthodontic or surgical purposes were included. Patients received a thorough explanation of the experimental rationale, clinical procedures, and possible complications. All the patients gave their informed consent. All experimental protocols were reviewed and approved by the Local Ethics Committee of Pomeranian Medical University, Szczecin, Poland (approval number KB-0012/39/11).

A standardized therapeutic procedure was used. According to the operative protocol, each tooth was radiologically examined to exclude the presence of caries or periapical pathology. Thermal testing (Kältespray; M&W Dental, GmbH, Büdingen, Germany) and electric sensitivity testing (Vitality Scanner pulp vitality tester; SybronEndo, Orange, CA) were performed to assess pulp vitality. The teeth were mechanically cleaned and disinfected with 0.2% chlorhexidine solution before cavity preparation. After the induction of local anesthesia and application of a rubber dam, occlusal class I cavities were prepared using round carbide burs under air–distilled water cooling. An exposure measuring approximately 1.2 mm in diameter was created using round carbide burs under air–distilled water cooling. New burs were used for each procedure. Bleeding was controlled with saline irrigation, and a sterile cotton pellet was placed on the site of pulp exposure.

The teeth were randomly divided into 4 groups (n = 11 each) depending on the pulp capping material used. In group 1 (CH group), the exposed pulp and surrounding dentin were capped with Ca(OH)₂, pastes Calcipast (Gerkmad, Stalowa Wola, Poland), Life (Kerr Hawe, Salerno, Italy), and Single Bond Universal with Filtec Ultimate (3M ESPE) according to the manufacturer’s recommendations. In group 2 (MTA), the exposed pulp and surrounding dentin were capped with ProRoot White MTA (Dentsply, Tulsa Dental, Tulsa, OK) according to the manufacturer’s recommendations. After MTA application, the operator laid a flat, water-moistened cotton pellet directly over the material and provisionally restored the tooth with glass ionomer cement (Ketac Molar, 3M ESPE). In group 3 (BIO), the exposed pulp was capped with Biodentine according to the manufacturer’s recommendations. Biodentine was also used for the temporary restoration so that the entire cavity was filled with bioactive cement. Patients in both groups 2 and 3 returned to the clinic for clinical examination and final composite restoration after 7 days. The operator additionally verified the setting of MTA. In group 4 (SBU), the exposed pulp and surrounding dentin were capped with Single Bond Universal with Filtec Ultimate according to the manufacturer’s recommendations.

Six weeks after application of the pulp capping material, all teeth were extracted with minimum trauma by a designated oral surgeon. The extracted teeth were then subjected to CBCT imaging and light microscopy as described later.

Light Microscopy

After fixation for 2 weeks in 10% buffered formalin solution, the extracted specimens were demineralized in nitric acid and embedded in paraffin. Two- to 3-μm-thick serial sections cut in the lingual-buccal plane were stained with hematoxylin-eosin (H&E). The Brown and Brenn technique was used to stain bacteria. Coded samples were used throughout the study to avoid possible bias. Qualitative and quantitative histopathological analyses were performed on the H&E-stained specimens using an optical microscope (Imager D1 Axios; Carl Zeiss, Goettingen, Germany) connected to a high-resolution video camera (Axio Cam MRc5; Carl Zeiss Microimaging, Thornwood, NY). Examinations were performed under normal and ultraviolet (UV) light using 38 HE (eGFP) and 43 HE (Cy 3) filters (Carl Zeiss, Goettingen, Germany) by an experienced examiner. The amount of hard tissue formation at the interface of the capping material was analyzed using the previously described criteria (16).

CBCT Imaging

CBCT images (Cranex 3D, No. SE 1100155, Software Version Scanora 5.1.0.9; Soredex, Tuusula, Finland) were obtained to identify reparative dentin bridges on original and multiplanar reconstruction images using the dedicated OnDemand3D App 1.0.9.15435 software (Soredex, Tuusula, Finland) (Fig. 1A). Subsequently, a serial profile of the dentin bridge formed from the coronal (the first virtual slice) to the cervical sections (last virtual slice) was ascertainned using 0.133-mm axial slices of the tooth; this allowed for the calculation of the estimated thickness. A series of axial images showing the mineralized reparative tissues formed over the exposed pulp are shown in Figure 1B.

The Osirix (Version 4.1.2.32 bit; Pixmeo, Geneva, Switzerland) software was used to analyze the axial images, and the findings from the axial and multiplanar reconstruction images were compared with those of histologic examinations. The width (contrast) and level (brightness) of the window (approximately 2000/4500) were used to precisely show the plane of the formed bridge, and it was ensured that this plane was consistent with that on the representative histologic section of the thickest reparative dentin bridge (Fig. 2A). The use of the UV filter shave allowed for further clarification of the dimensions of the bridge (Fig. 2A1 and A2). The boundary between the dentin bridge and pulp tissue was established using the upper limit of the pulp density and was confirmed from the peak on an individual histogram for each specimen (Fig. 2B). Then, the dimensions of the dentin bridge obtained from histologic examination were transferred to a CBCT image to determine the boundary between the dentin bridge and the filling. Points were located individually for each tooth at the lower limit of the density values to eliminate artifacts. After merging the points, an arc depicting the limiting surface was plotted and used to ascertain the density of the dentin bridge.

To evaluate the characteristics of each tooth, the densities of the pulp; young dentin, which was located immediately proximal to the pulp; and mature dentin, which was located external to the young dentin, were determined. The density of young dentin was determined by drawing an ellipse with a surface area of 500,000 μm². Mature
The area of the dentin bridge was encircled on each reconstructed layer to establish the spatial structure and calculate the volume using the aforementioned principle and Osirix software. The resulting surfaces were compared with images of histologic sections of successive tooth layers. Thus, areas of the dentin bridge (regions of interest) obtained were summed up to derive the volume (Fig. 2C–F).

The volume of the bridge was measured and assigned to 4 groups according to the authors’ classification: 1, no dentin or unmeasurable volume of dentin; 2, low volume (<0.1 mm³); 3, moderate volume (0.1–0.5 mm³); and 4, high volume (>0.5 mm³). Because the minimum measurable distance was limited by tomography resolution, very small bridges were measurable only on histologic images.

**Statistical Analysis**

All continuous variables were checked for normality of distribution using the Kolmogorov-Smirnov test. Statistical differences between the 2 groups were identified using the Student t test and the Mann-Whitney U test. Analysis of variance and the Kruskal-Wallis test were applied for analysis of the groups. Any correlations between discrete variables were studied using the Pearson chi-square test and the Fisher exact test. Differences were considered statistically significant at P < .05.

**Results**

**Light Microscopy**

Clinically, pulp capping success was found in all teeth after 6 weeks. No detectable periradicular radiographic changes were observed. Teeth from all groups responded positively to electric pulp testing immediately before extraction.

Histologic examinations revealed the formation of 37 dentin bridges. The maximum and average thicknesses of the dentin bridges are shown in Figure 3. Ca(OH)₂, MTA, and Biodentine actively initiated the formation of reparative dentin in each tooth (n = 11), whereas Single Bond Universal was significantly less active and induced the formation of 2 small (Fig. 4C) and 2 very small bridges (n = 4). At high magnification, the reparative hard tissues in the CH and SBU groups had an uneven thickness and exhibited porosities and tunnel defects (Figs. 2A2 and 4C), whereas those in the MTA and BIO groups were thicker and more homogeneous with minimal tunnel defects (Fig. 4A and B). The thickness of the dentin bridges in the Ca(OH)₂, MTA, and BIO groups was significantly greater than that in the SBU group, whereas there were no significant differences among the CH, MTA, and BIO groups. There was no bacterial staining in any section.

**CBCT Imaging**

The average densities of young dentin, mature dentin, dentin bridges, and pulp in the 4 groups are shown in Figure 5. Mature dentin had the highest average density (2275.5) followed by young dentin (1714.0), dentin bridges (1179.1), and pulp (160.6). The largest difference in density of the tissue was observed in young dentin and dentin bridges, whereas the smallest difference was observed in mature dentin and pulp.

The highest and lowest average densities of dentin bridges were recorded in the MTA (1253.9) and SBU groups (1076.0), respectively, whereas the values in the CH and BIO groups were similar. However, statistically significant differences (Mann-Whitney U test) were observed...
between the MTA and CH groups (P = .011). Particularly large differences in density and structure were observed among the dentin bridges formed in the CH and SBU groups (Figs. 2 and 4).

Tomographic evaluations confirmed the presence of 25 bridges out of the 37 identified by histology. The results for all specimens are provided in Table 1 and Figures 1 and 4. The volume of reparative dentin formed was moderate in the Ca(OH)$_2$ group and moderate to high in the MTA and BIO groups, with no significant differences between the latter 2 groups. In the SBU group, only 2 bridges with a small volume were identified. Reparative tissue with radiolucent tunnel defects is visible in Figure 4C. Significant differences in dentin bridge volume were observed between the CH, MTA, and BIO groups and the SBU group (Table 1). Notably, the reparative dentin bridges in the BIO group showed the highest average and maximum volumes compared with that in the other 3 groups (Table 2). Biodentine and MTA resulted in the formation of bridges with a significantly higher average volume compared with Single Bond Universal.

**Discussion**

To our knowledge, the present study is the first to assess reparative dentin formation using CBCT imaging in relation to the gold standard, which is histologic examination. CBCT images allow the acquisition of 3-dimensional images of dentin bridges and enable their qualitative assessment (24, 26, 28). The results of our study showed that Ca(OH)$_2$, MTA, Biodentine, and Single Bond Universal had different degrees of influence on dentin bridge formation, with the former 3 positively affecting the exposed pulp and actively initiating the formation of reparative dentin in each tooth and the latter one resulting in the formation of significantly lesser dentin bridges of a...
lower quality, thickness, and volume. Therefore, the null hypothesis that there is no difference in the quantity and quality of reparative dentin bridges formed after direct pulp capping with these different materials in humans is rejected.

The disadvantage of CBCT imaging is a lower contrast and higher background noise (28, 29). Crown nodules, fillings, and dentures result in artifacts on CBCT imaging in addition to local band beam-hardening artifacts of “cupping”; therefore, it is necessary to define an algorithm to eliminate these artifacts (25). In our study, to eliminate artifacts from the CBCT images, each tooth was scanned separately. Furthermore, we used a standardized methodology to identify and determine the spatial structure of the dentin bridges. For best visualization of the dentin bridge, we used the parameters of width and window level and ensured that the plane was compatible with that on the representative histologic section of the thickest dentin bridge. Dentin bridges with the highest average and maximum volumes were formed after the use of Biodentine followed by the use of MTA, Ca(OH)2, and Single Bond Universal (C1, C2, and C3). (A–C) The dentin bridge (H&E; original magnification, ×25). (A1, B1, and C1) Higher magnification seen through the 38 HE (eGFP) filter (original magnification, ×50). (A2, B2, and C2) Higher magnification seen through the 43 HE (Cy 3) filter (original magnification, ×400). D, dentin; DB, dentin bridge; P, pulp. Open arrowhead indicates the tunnel defect.

Evaluation of tooth mineralization is crucial for understanding the repair and pathological processes occurring in the pulp. Although the CBCT diagnostics used in this study have sensitivity lower than that of light microscopy, they can provide additional information on tertiary dentin mineralization (24, 26, 28). The authors observed regions with different levels of mineralization on CBCT images, which is not possible in demineralized histologic sections. Histograms were plotted to facilitate data analysis and determine the distribution of gray tones in the images, which helps in assessing the homogeneity of the structure and mineralization of the dentin bridge (28).

In previous studies (10, 30), micro–computed tomographic images obtained 4 months after direct pulp capping with Ca(OH)2, MTA, and white Portland cement in baboons showed the presence of tissue resembling osteodentin, which was suggested by the researchers to be the result of dystrophic calcification. Compared with these studies (10, 30), our study obtained better results in terms of the quality of tissue repair. Ca(OH)2 induced the formation of a thick but very porous reparative dentin bridge (10). This porosity may facilitate the entry of bacteria into pulp (3, 11, 14). Particularly large variations in density were observed among the dentin bridges formed in the SBU and CH groups. These variations, along with those in the structure of the dentin bridges, can be attributed to the content of particulate material in the reparative tissues, as observed in the histologic sections. The particles of material present in the dentin bridge tissue can also affect the growth of density values. Micro–computed tomographic imaging, which was used in previous studies (10, 30), ensures a high-resolution and consistent phenotype and is more accurate than CBCT imaging. Unfortunately, because of the high doses of radiation, this modality cannot be used in in vivo studies (29).

The ability of Ca(OH)2, MTA, and Biodentine to induce the formation of reparative dentin bridges in rat (14) and pig (15) pulp injury models was previously investigated. A significant difference was observed at 7 days after pulp capping between Biodentine and
Ca(OH)₂ (15) although at 28 and 90 days there was no significant difference between MTA, Biodentine, and Ca(OH)₂ in terms of hard tissue formation, which is similar to the results of our study. The reparative tissues induced by MTA and Biodentine were homogeneous, whereas those induced by Ca(OH)₂ were porous, suggesting a reparative process different from that induced by calcium silicate (14, 31). Studies indicate greater tissue repair efficiency of calcium silicate compared with that of Ca(OH)₂, probably because of the recruitment of pulp stem cells by the former. These cells regulate the expression of transcription factors such as RUNX2, which are involved in the process of molecular dentinogenesis (14, 32). Stimulation of cell proliferation and differentiation may be related to calcium silicate itself, which is one of the main components of MTA and Biodentine (14, 16, 17, 33).

Chang et al (31) observed a similar increase in alkaline phosphatase activity, deposition of mineralized nodules, and up-regulation of markers for odontoblastic differentiation in MTA and Biodentine. Other researches (18, 34) after direct pulp capping in animal teeth noticed that Biodentine showed significantly higher stimulatory activity on pulp cells in comparison with MTA, resulting in thicker reparative dentin bridges and greater incidence of ectopic pulp calcification in developing teeth. In our study, dentin bridges in the Biodentine group showed the highest maximum thickness and average and maximum volumes.

Application of Single Bond Universal elicited responses similar to those observed with the use of bonding systems in humans (6, 9, 35). Despite the good seal and satisfactory biocompatibility, their ability to induce dentin repair was significantly weaker than that of Ca(OH)₂ and calcium silicate–based materials (5, 6, 9, 35). In a previous study (5), MTA gave a more predictable, positive response in vital pulp therapy compared with Ca(OH)₂ and acid-etched dentin bonding systems over longer time frames. Therefore, in consideration of the fact that bonding of resins to the underlying tissue deteriorates over time in the absence of a dentin bridge, which increases the risk of pulp infection, the use of these preparations on exposed pulp should be carefully considered (36). In addition, the primer may continue etching the dentin for some time, causing an area of demineralization that is not filled with the bonding system (37).

Some researchers, because of the lack of a correlation between the presence of bacteria and the condition of the pulp, indicate that the toxicity of the materials used could be a cause of the absence of dentin bridge formation (21). The components of bonding systems can be cytotoxic to cells and microorganisms and can adversely affect the immune system and induce immunosuppression (38). In a recent study in humans (7) in which Single Bond Universal was applied using the total-etch technique during the clinical procedure of direct pulp capping, light microscopy and scanning electron microscopy revealed subclinical adhesive failure as opposed to the satisfactory visual results. Residual monomer, resin tags at the margins of the exposed pulp, and blood and gaps between the adhesive layers were also observed (7). The results of our study and those of previous studies confirm that materials such as MTA, Biodentine, and Ca(OH)₂ are preferred over bonding systems such as Single Bond Universal for direct pulp capping.

The present study was conducted under controlled experimental conditions using third molar human teeth to avoid the interference by confounding factors. The fact that the teeth had healthy pulp tissue in all groups means that differences encountered in the pulp can be attributed exclusively to the capping material used. The intensity of the pulp reactions demonstrated in healthy teeth may be lower than in carious teeth (39).

**Conclusion**

In conclusion, the volume of formed reparative dentin bridges depends on the material used for direct pulp capping. Biodentine and MTA

---

**Figure 5.** Mean values of the density for the mature dentin, young dentin, dentin bridge, and pulp in the 4 groups.

**TABLE 1.** Volumes of Reparative Dentin Bridges after Direct Pulp Capping with the 4 Different Materials

<table>
<thead>
<tr>
<th>Volume of dentin bridge</th>
<th>CH* (n = 11), n (%)</th>
<th>MTA† (n = 11), n (%)</th>
<th>BIO‡ (n = 11), n (%)</th>
<th>SBU*,†,‡ (n = 11), n (%)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>No dentin (0) or unmeasurable volume</td>
<td>4 (36.4)</td>
<td>3 (27.3)</td>
<td>3 (27.3)</td>
<td>9 (81.8)</td>
<td>19</td>
</tr>
<tr>
<td>Low volume</td>
<td>2 (18.2)</td>
<td>0</td>
<td>1 (9.1)</td>
<td>2 (18.2)</td>
<td>5</td>
</tr>
<tr>
<td>Moderate volume</td>
<td>4 (36.4)</td>
<td>6 (54.6)</td>
<td>4 (36.4)</td>
<td>0 (0.0)</td>
<td>14</td>
</tr>
<tr>
<td>High volume</td>
<td>1 (9.1)</td>
<td>2 (18.2)</td>
<td>3 (27.3)</td>
<td>0 (0.0)</td>
<td>6</td>
</tr>
<tr>
<td>Total</td>
<td>11</td>
<td>11</td>
<td>11</td>
<td>11</td>
<td>44</td>
</tr>
</tbody>
</table>

Pearson χ² test: P = .0634

BIO, Biodentine; CH, calcium hydroxide; MTA, mineral trioxide aggregate; SBU, Single Bond Universal.
* Spearman’s rank, P = .0119.
† Spearman’s rank, P = .0011.
‡ Spearman’s rank, P = .0017.
induced the formation of bridges with a significantly higher average volume compared with Single Bond Universal in this study, and CBCT imaging allowed for the identification of the location of dentin bridges. Determination of the precise location and measurement of the volume of dentin bridges on CBCT images is very difficult without correlation with histologic findings because of certain limitations of CBCT imaging, such as a low contrast, background noise, and a small area of evaluated tissue. Further studies using computed tomographic imaging and electron microscopy are required for a more precise evaluation of reparative dentin bridges formed after direct pulp capping with various materials.

Acknowledgments
The authors deny any conflicts of interest related to this study.

References

BIO, Biodentine; CH, calcium hydroxide; MTA, mineral trioxide aggregate MTA; Q1, first quartile (25th percentile); Q3, third quartile (75th percentile); SBU, Single Bond Universal; SD, standard deviation.

**Mann-Whitney U test, P < .05.**

### TABLE 2.
Mean Volumes of Reparative Dentin Bridges Formed after Direct Pulp Capping in the 4 Groups

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>Mean</th>
<th>Median</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Q1</th>
<th>Q3</th>
<th>SD</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>CH</td>
<td>7</td>
<td>0.30</td>
<td>0.33</td>
<td>0.07</td>
<td>0.56</td>
<td>0.09</td>
<td>0.39</td>
<td>0.17</td>
<td>.009</td>
</tr>
<tr>
<td>MTA*</td>
<td>8</td>
<td>0.45</td>
<td>0.31</td>
<td>0.19</td>
<td>1.27</td>
<td>0.22</td>
<td>0.52</td>
<td>0.37</td>
<td></td>
</tr>
<tr>
<td>BIO*</td>
<td>8</td>
<td>0.47</td>
<td>0.27</td>
<td>0.09</td>
<td>1.82</td>
<td>0.20</td>
<td>0.69</td>
<td>0.41</td>
<td></td>
</tr>
<tr>
<td>SBU*</td>
<td>2</td>
<td>0.07</td>
<td>0.07</td>
<td>0.06</td>
<td>0.08</td>
<td>0.06</td>
<td>0.08</td>
<td>0.01</td>
<td></td>
</tr>
</tbody>
</table>