Comparison of Relining and Rebasing Materials in Removable Dentures

Porovnanie mäkkých rebazačných materiálov pri snímateľných náhradách

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ABSTRACT

INTRODUCTION: The aim of this study was to provide the latest and comprehensive knowledge about soft relining materials in general. It should highlight the indications and properties of these materials from a clinical as well as a technical standpoint.

METHODS: Within a comparative study, three permanent soft relining materials of three different manufacturers were employed. These materials were added to conventional resin base plates and observed over a period of 70 days, while being stored in water bath. The changes in shore hardness A, and in the overall weight were tracked over a period of 70 days, measuring every 14 days. Finally, a discoloration test has been performed in which two solutions were employed, documenting the discoloration via photographs every 14 days over a period of 70 days.

RESULTS: The biggest increase of Shore hardness A was observed within the first 14 days for both dual-component autopolymerisation materials. On the other hand the single component heat-polymerised material presented insignificant changes; hence it is more chemically stable compared to the first two materials. In regards of weight changes, although the two dual-component autopolymerisation materials rendered an increase of weight as they are more porous, thus rendering more water absorption. Regarding the discoloration, all three materials may be recorded as discoloured for solutions , where there was no visual difference between the two used solutions.

Keywords: soft relining materials, shore hardness A, water absorption, discolouration.

ABSTRAKT

ÚVOD: Cieľom štúdie bolo poskytnúť najnovšie a komplexné vedomosti o mäkkých rebazačných materiáloch všeobecne. Štúdia by mala zdôrazňovať indikácie a vlastnosti daných materiálov z klinického aj technického hľadiska.

METODIKA: Vrámci porovnávacej štúdie boli použité tri trvalé mäkké rebazačné materiály od troch rôznych výrobcov, následne boli tieto materiály pridané na konvenčné živicové platne a pozorované počas 70 dní ponorené vo vodnom kúpeli. Zmeny tvrdosti shore A a celkovej hmotnosti sa sledovali počas 70 dní, merania boli uskutočnené každých 14 dní. Ďalej sa vykonal test sfarbenia, pri ktorom sa použili dva rôzne roztoky, a farebné zmeny boli zdokumentované priebežne každých 14 dní počas 70 dní.

ZÁVER: Najväčší nárast tvrdosti shore A bol pozorovaný v priebehu prvých 14 dní pre oba dvojzložkové autopolymerizačné materiály. Na druhej strane, teplom polymerizujúci materiál s jednou zložkou predstavoval bezvýznamné zmeny; teda je chemicky stabilnejší v porovnaní s prvými dvoma materiálmi. Pokiaľ ide o zmeny hmotnosti, dva dvojzložkové autopolymerizačné materiály spôsobili zvýšenie hmotnosti, pretože sú poróznejšie, čím sa zvýšila absorpcia vody. Všetky tri porovnávané materiály vykazovali farebné zmeny po ponorení do oboch roztokov, pričom medzi týmito dvoma roztokmi neboli žiadne vizuálne zmeny.

Kľúčové slová: mäkké rebazačné materiály, tvrdosť shore A, absorpcia vody, farebné zmeny.

INTRODUCTION

Soft denture relining materials are used in complete and partial removable dentures and have a vast spectrum of application. Their major function is to facilitate the distribution of masticatory forces homogenously onto tissue bearing surfaces of the oral cavity (Hashem, 2015). Hence soft or resilient denture relining materials may provide enhanced comfort to complete or partial removable prosthesis patients. Especially suitable are these kinds of materials used immediately after surgical intervention such as implantation and extraction, when incorrectly directed pressures on the surgical wound need to be avoided. Also in complicated anatomical structures like atrophic mucosa, non-keratinized surfaces in the area of the alveolar ridges caused by improper tissue grafting, presence of bony undercuts as well as irregular bone resorption (Bail et al.,2013). Furthermore soft relining materials may be indicated in cases of bruxism and in patients diagnosed with xerostomia (Hashem, 2015).

Overall the materials can be classified into two types upon their chemical structure. It is either acrylic resin or silicone based and is incorporated into the prosthesis via direct chairside or indirect laboratory methods. Secondly they are grouped into short and long term materials inevitable to know for their indications. Short term materials are amorphous polymer liners

that can be used only for a couple of days to a week (Dorocka-Bobkowska et al., 2017). The International Organization for Standardization (ISO) estimated in ISO 10139-1:2018 a period of 7 days in which these kind of materials are safe and reliable to use. Long-term soft relining materials sustain their overall properties for more than one year. Numerous authors like Chladek et al. (2014) mention a maximum remaining time of up to one year, in which the materials are considered to be functional and safe. Long term materials are further defined by ISO 10139-2:2016, in which the requirements for adhesion, water sorption, softness and water solubility are specified in detail. Long term materials are predominantly indicated in edentulous patients with sharp atrophied alveolar ridges covered by atrophied mucosa and gingiva without further prosthodontic or surgical treatment planned. Especially after extensive surgical procedures such as mucosal flap reconstruction, in which the unfavourable displacement of keratinized gingiva and/or non-keratinized mucosa is highly possible. They are also useful to overcome the problem of chronic sores of non-healing nature, in dentures with poor retention, in combination with obturators and in the field of dental implantology (Chladek et al.,2014). The positive effects of such long term materials are mainly carried out by the means of widespread force distribution and not as previously suspected, by effectively reducing the net sum of masticatory forces applied to oral tissues (Braden et al.,1995).

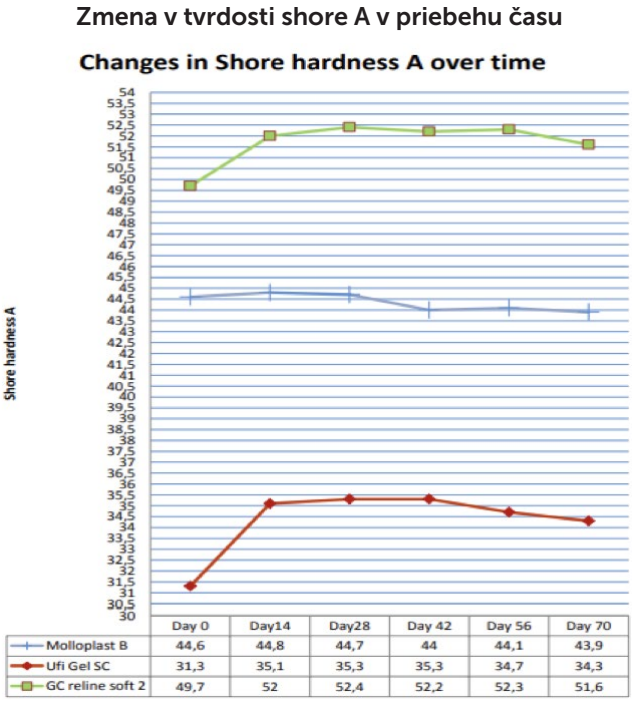
METHODS

Within this comparative study three permanent soft relining materials of three different manufacturers were employed. More specifically, Molloplast B (DETAX GmbH & Co. KG; Ettlingen, Germany), GC reline soft 2 (GC Co. Ltd ; Tokyo, Japan)and Ufi Gel SC(VOCO GmbH; Cuxhaven, Germany), whereby Molloplast B is a heat polymerized single-component silicone. Contrary to that, GC reline soft 2 and Ufi Gel SC are cold polymerized dual-component A-silicones. All of these materials were processed exactly according to manufacturer's manual. More specifically, Molloplast B (DETAX GmbH & Co. KG;Germany), GC reline soft 2 (GC Co. Ltd;-Japan) and UfiGel SC (VOCO GmbH;Germany). In order to conduct the experiment as realistic as possible, it was decided to apply the soft relining materials on conventional resin base plates. The resin base plates were constructed with the help of robust wax plates (Special Modelling Wax (summer) 1,5mm; gebdi DENTAL -PRODUCTS GmbH; Engen, Germany) and of a 3D-printed resin scaffold. For this procedure the wax plates were evenly heated until a soft-plastic state was achieved. The plastic wax was placed into a heating bath at 35°C to soften. The wax plates with the dimension of 30 mm x 30mm and a thickness of 1,5mm were obtained by pressing the 3D-printed scaffold into the softened plastic wax. After this process the dimensions have been metrically verified by using a calliper. For processing, the wax plates were placed on a levelled glass plate. To ensure a future resin base plate thickness of 3mm, two wax plates were laid on top of each other. By means of a simple encircling scaffold and duplication silicone (Mega SIL PLUS 30; Megadental GmbH; Büdingen, Germany)a negative form was produced.

Finally a discolouration test has been conducted in which two solutions (coffee and red wine) were employed. One testing sample from each manufacturer was submerged in each solution. The testing samples were photographed before they were submerged as well as every 14 days at a total period of 70 days (in total 6 photographs). Before photographs were taken on a white background, the surface has been rinsed to remove any possible sediment. Moreover both discolouring solutions were renewed every 14 days at the time of photo.

CONCLUSION

Results in shore hardness: The initial Shore hardness A (day 0) of Molloplast B was 44,6 (±1,16), that of GC reline soft 2 was 49,7 (±1,66) and Ufi Gel SC presented with 31,3 (±0,4). After a total of 70 days of being stored in the water bath, Molloplast B had a Shore hardness A of 43,9 (±1,28) meaning there was a decrease in Shore hardness A of -1,57 %. The changes for Molloplast B are insignificant following a two-tailed significance test (P<0,05). The final Shore hardness A for GC reline soft 2 was 51,6 (±2,13) and for Ufi Gel SC was 34,3 (±0,4). Resuming there was a total increase of 3,82% for GC reline soft 2 and 9,85% for Ufi Gel SC. Therefore Ufi Gel SC was found to have the highest changes in Shore hardness A, whereas Mollplast B had the least noticeable changes. For the last two materials the changes were tested as statistically significant for a two-tailed significance test (P<0,05).



	Day 0	Day14	Day28	Day 42	Day 56	Day 70
Molloplast B	44,6	44,8	44,7	44	44,1	43,9
Ufi Gel SC	31,3	35,1	35,3	35,3	34,7	34,3
GC reline soft 2	49,7	52	52,4	52,2	52,3	51,6

Diagram 1. Changes in Shore hardness A for Molloplast B (blue line), GC reline soft (green line) and Ufi Gel SC (red line). X-axis: represents the time points of measurement with an interval of 14 days over a total period of 70 days. Y-axis: represents the Shore hardness A within a range between 30 and 54.

Graf č. 1: Zmeny v tvrdosti shore A u Molloplast B (modrá krivka), GC reline soft (zelená krivka) a Ufi Gel SC (červená krivka). Os X predstavuje časové body meraní v 14-dňovom intervale počas 70 dní. Os Y predstavuje tvrdosť Shore A v rozsahu 30 až 54.

Weight change: MolloplastB showed an initial decrease of weight change percentile until day 42(-0,17%) followed by a steep increase at day 56 (-0,10%) and repeated decline at day 70 (-0,14%). GC reline soft 2 had a final weight of 9,28998g (±0,684g) which equals a weight increase of 0,03%. GC reline soft 2 showed an initial increase of weight change percentile until day 14 (+0,04%) followed by a decline at day 28 (-0,01%). After a plateau phase between day 28 and day 42, the weight again increased by 0,05% at day 56. Finally there was a decline at day 70 to 0,03%. Ufi Gel SC presented with a final weight of 8,69502g (±0,4641g) thus representing a total weight increase of 0,07%. Ufi Gel SC showed an initial increase of weight change percentile until day 14 (+0,04%) followed by a decline at day 28 to +0,02% compared to day 0. After a plateau phase between days 28 and day 42, the weight again increased by

0,12% on day 56. Finally there was a decline on day 70 to 0,07%. All three materials showed, according to a two-tailed significance test (P<0.05), statistically significant changes in weight after a period of 70 days in the water bath.

Zmena hmotnosti v priebehu času

	Day 0	Day14	Day28	Day 42	Day 56	Day 70
Molloplast B	0	-0,10%	-0,16%	-0,17%	-0,10%	-0,14%
Ufi Gel SC	0	0,04%	0,02%	0,03%	0,12%	0,07%
GC reline soft 2	0	0,04%	-0,01%	-0,002%	0,05%	0,03%

Diagram 2. Changes of weight for Molloplast B (blue line), GC reline soft 2 (green line) and Ufi Gel SC (red line). X-axis: represents the time points of measurement with an interval of 14 days over a total period of 70 days. Y-axis: represents weight change in percent in relation to the initial weight (Day 0) within a range between -0,002% and +0,0015%.

Graf č. 2: Zmeny hmotnosti pre Molloplast B (modrá krivka), GC reline soft (zelená krivka) a Ufi Gel SC (červená krivka). Os X predstavuje časové body meraní v 14-dňovom intervale počas 70 dní. Os Y predstavuje percentuálnu zmenu hmotnosti vo vzťahu k počiatočnej hmotnosti (Deň 0) v rozsahu -0,002% až +0,0015%.

Discoloration: In regards to the discoloration, all three materials may be recorded as discoloured for both red wine and coffee solution.

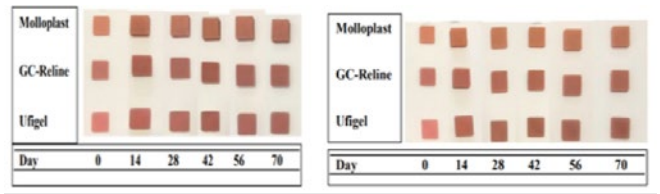


Fig. 1 (left): Serial photographs of discolouration test implementing a red wine solution.

Fig. 2 (right): Serial photographs of discolouration test implementing a coffee solution.

Obr. 1 (vľavo): Sériové fotografie testu odfarbenia s použitím roztoku červeného vína.

Obr. 2 (vpravo): Sériové fotografie testu odfarbenia s použitím roztoku kávy.

DISCUSSION: The changes in shore hardness A for GC reline soft 2 and Ufi Gel SC are statistically significant. These silicone-based dual curing materials presented themselves with a steep increase of shore hardness A between day 0 and day 14, which may be due to prolonged curing after the initial setting has taken place. Mancuso et al. (2009) described the same phenomenon when dealing with autopolymerisation material. As the shore hardness A of the dual curing materials did not change profoundly after day 28, it may be an evidence for prolonged chemical curing following initial material setting within the period in between day 0 to day 28.

On the other hand, the changes in shore hardness A for Molloplast B have been insignificant within the tested time period. Such behaviour was already expected, since it is a single component heat curing silicone and thus, according to Hayakawa et al. (2003), rendering less porosity and water absorption which affects the hardness.

The disadvantage of discoloration is a major obstacle when employing any kind of soft denture relining material. As already stated by various authors there are differences among various material types and staining solutions. The discolouration test revealed similar staining for all three materials and both staining solutions. Similar results were also observed by Imirzalioglu et al. (2009). Due to technical limitations the evaluation of discolouration was only of visual comparative nature, therefore statistical significance testing was not possible. For future investigations it would be necessary to employ a colorimeter in order to reveal the underlying significance.

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