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A Study on Fracture Resistance in the Treatment of Class II Cavities with Pins

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1. Background

The history of pins in molars is back in 1839-1855. Their use is mainly in the restoration of large cavities first with amalgam and then with esthetic resin materials. Between 1958-2008 for a period of 50 years only 70 publications appear which are related to the topic. This is due to the difficulties in the clinical and non clinical research on pins. The articles focused on class II cavities are mainly about adhesive or non adhesive amalgam pins restorations.

Cors and build ups with esthetic resin materials appears later, after 1970 and are much less – about 15 papers. The list of indications usually includes the replacement of a cusp with a pin, but no more than 4 to 6 pins, when all cusps are missing (11, 16). A different approach is the one of Burgess 1997 (4), who proves that the retention is much better when pins are not

The research on aesthetic materials are since 1970 and are with resin materials, glass ionomers, with and without bondings (1,5,6). All types of class two cavities are preparated like: mesio- and disto-occlusal and MOD and the measurements are on the gaps, microleakage, comprehensive strength, fracture resistance (1,5,6,8).
In vitro tests are more common method as well as first and second molars, instead of premolars or third molars. Butchard 1988 (3) theory is that experimental conditions on pins are not comparable with real clinical environment. According to the same author pins can lower the fracture resistance when they are used with resin materials. This is a vision based on the knowledge of materials before the multifunctional bonds.

The clinical studies are very rare in the field of pins and class II cavities.

Unsolved problems remains and they are about microleakage, abrasive properties in resin materials, corrosion in amalgam restorations and metals and interactions between pins and cements with metal particles and with metals from prosthetic constructions.

2. Aim

The **aim** of the present study is to test the role of pins in the fracture resistance of class II bonded restorations with amalgam and resin materials.

3. Materials and Method

Fifty matured human upper and lower sound molars with straight roots are placed in the respective groups: upper - 20, lower -30, with similar numbers with or without pins, 24 with dental amalgam and 26 with resin material. The cavity preparation of class II cavities is with the absence of 2/3 from the cusp distance of the occlusal surface, a wall and a cusp on each tooth. The respective sizes of the cavities are related to the sizes of the particular crowns with comparable volume of cavities. This dimentions are for upper molars-BL 5-6 mm, GW 7-8 mm and for lower molars-BL 6,5-7,5 mm, GW 7-7,5 mm. All cavities depth was 3-3,5 mm. All restorations were prepared according to the manufacturers instruction with dental amalgam and resin material and bonded with multifunctional bond - Prime bond NT. The termocycling in wet conditions was 30 days in 30ºC in saline solution, 100% humidity, 60 days and 100 dry cycles, 20 seconds each in the following order - 45ºC±3ºC, room temperature, 5ºC, room temperature. The dry cycling was in two series 50 each with two days intervals in humid environment in Cultura incubator of Viva Dent 55ºC and ice – 4ºC with equal mean intervals at room temperature. Fracture resistance was tested with a universal testing machine Instron type for vertical loading, used to test loading in Newtons (N), from 20 N, speed of 0.5 mm/min, displacement from 0.1 mm.

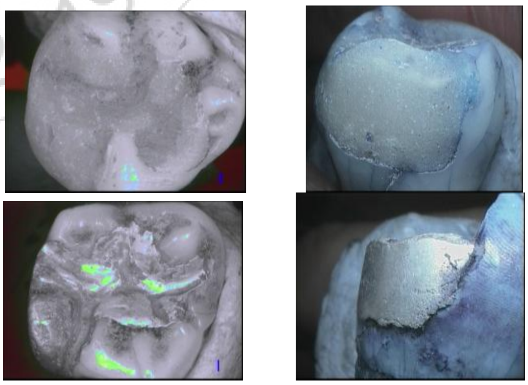

Figure 1 a-d: Specimens in groups after wet and dry cycles and before the tests

Figure 2: Specimens in groups ready for loading and for the fracture resistant tests

Statistics: Graphic and Table Analysis, ANOVA and Tukey post hoc analysis

4. Results

The observed findings are equally not related to upper and lower teeth and to the small variations in the sizes of the cavities. One Newton is equal to 9.81 kilogram force - kgf.

Treatment of class II cavities with pins and dental amalgam is increasing the fracture resistance of the restorations: 234 to 323 kg (2293-3167 N).

Lower resistance is observed when resin materials are used without pins: 163 to 264 kg (1599-2592 N).

The treatment planning of pins in class II cavities is strongly related to the type of occlusion and to the nature of the opposite teeth (enamel, ceramics, etc.).

Table 1: Results from the registered fractures and means from the fractures resistance tests and p values

Group	Teeth	Load in N	P values p<0.05	Load in Kgf
3A	8	2293,09	v/s 3B	233,75
4A	14	3167,23	v/s 4B	322,85
3B	10	1599,03	v/s 3A	163,0
4B	13	2592,10	v/s 4A	264,23

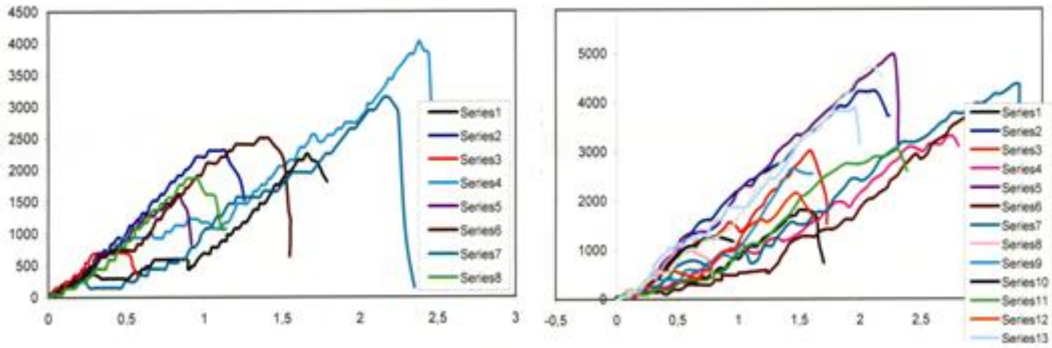

Figure 3 a, b: Graphs of the fracture resistance tests of groups 3A and 4A

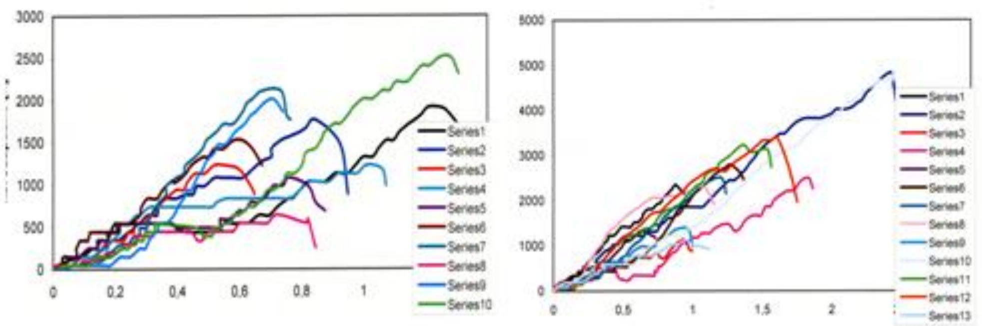

Figure 4 a, b: Graphs of the fracture resistance tests of groups 3B and 4B

5. Discussion

In a study published recently on fracture strength of glass ceramic inlays 2849.0-2646.7 ±360.4 N, glass ceramic onlays – 1673.6 ±677.0 N and zirconia onleys – 2796.3 ±337.3 N the vertical loading is compared with controls of sound molars – 2905.3 ±398.8 N (14). This data is comparable with the present results, found with pins and dental amalgam in the fracture resistance of the restorations 2293-3167 N. They are similar to the sound teeth and glass ceramic inlays. Lower resistance is observed when resin materials are used without pins 1599-2592 N, which is comparable to glass ceramic and zirconia onlays. In the groups without pins and particularly with resin materials more restorations are lost during cycling and much less forces were needed the teeth to be destroyed.

The excellent results with pins and dental amalgam are understandable. This is an adhesive amalgam treatment, and the amalgam is more resistant any way. In this case the clinical data can be expected to be even better, due to the abilities for gaps fillings of dental amalgam, which are better than any other dental material. This is related not only to the fracture resistance but to the abrasive resistance. These are key points when restorative treatments are performed with pins, due to the occurrence of complications of dental materials replacement, in the presence of pins. In dental research focused on pins this fact has been always a "soft spot" and remains out of the scientific topics, avoided in the discussions. In cases when replacements are necessary, often the solutions are devitalizations for prosthetic reasons, fixation of posts or dental crowns.

That can be a reason Burgess 1977 to conclude that when only one cusp is missing even in MOD cavities, better long term results can be achieved without pins (4).

On the other hand pins can reinforce restorations against axial and transversal forces (12, 15) and their benefits are out of discussion where the occlusion is traumatic and for pins/post and core restorations.

A classic view to the problems looks the one of Pickard (12) who sticks to a simple rule that the minimum of material all around the pin have to be 1.5 mm wide. Sticking to this classic rule can prevent all complications related to the insufficient volume of material around the pin or to its quite peripheric placement.

6. Conclusion

The treatment planning of pins in class II cavities must be related not only to the amount of lost hard dental tissues, but also to the type of occlusion and to the nature of the opposite teeth (enamel, ceramics, etc.).

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