

Original Research Article

Use of restorative materials for direct and indirect restorations in posterior teeth by Brazilian dentists

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Abstract

Introduction: Often, dentists perform procedures aiming at more esthetical than long-term clinical performance of restorations. **Objective:** To evaluate the prevalence of use of different direct and indirect restorative materials in posterior teeth. **Material and methods:** In 2004, a questionnaire was applied to 486 dentists living at five geographical regions of Brazil. The dentists answered a questionnaire containing four questions, in which they reported the most widely used restorative material for direct (amalgam, composite resin, and glass ionomer) and indirect restorations (gold, silver, and copper/aluminum alloys, indirect resin composites, and ceramics) and specified the reason for using the material type selected. **Results:** In 2004, amalgam was the direct restorative material most used by dentists at almost all regions, except from South region, where resin composite was the most used. Esthetics was the main reason stated for the use of resin composites. As for

indirect restorations, metallic restorations were the most used in Northeast (77.8%). No differences were found regarding the material type use between metallic and aesthetic materials at North, Southeast and Center-West regions. At South region, esthetic restorations were the most used. **Conclusion:** Despite the limitations of this present study, direct and indirect metallic restorations were the most common materials in 2004.

Introduction

The constant advancement of science and technology compels all professional to update mainly because globalization of modern society. Marketing power of dental material industries has influenced on decision process of restorative treatment, especially regarding the restoration type (direct or indirect; metallic or esthetic), so that the dentist is often obliged to perform procedures aiming at more esthetical than long-term clinical restoration behavior of restorations.

Considering the appealing of different materials, the dental professionals have to search for solid knowledge to select the material most adequate for each situation. The main advantage of direct restorative materials, i.e. dental amalgam and resin composite, is shorter chair time.

Dental amalgam is a material very used for restorations in posterior teeth [33], presenting adequate resistance to masticatory forces [13, 32]. However, despite its adequate clinical behavior, dental amalgam would be replaced by materials with better clinical behavior [1, 3].

Accordingly, resin composites have been largely studied due esthetical features, which make them popular as restorative material [7]. Moreover, resin composites have great potential to obtain satisfactory mechanical properties together with the controversies on dental amalgam and the search for less invasive procedures [31]. On the other hand, resin composite in posterior tooth restorations tend to be a more complex procedure, generally with small durability [35]. Within this context, the longevity of resin composite restorations may be influenced by many factors such as adhesive system, type and composition of resin composite, light-curing unit, restorative technique, etc. [16, 18, 37].

Since the introduction in 1972 by Wilson and Kent [38], glass ionomer materials have undergone many changes that improved clinical behavior and increased versatility in clinical practice, exhibiting properties as bonding to tooth structures, biocompatibility, fluoride release, among others, leading such materials to be increasingly researched [11, 14]. Notwithstanding, glass ionomer cements still do not have mechanical properties enabling effective use as direct restorative material in posterior teeth [10, 20].

Both resin composite and indirect restorative materials improved mechanical properties because of the improvement of adhesive systems and luting materials, respectively. The development of resin composites leads to development of resin cements, increasing the possibilities of constructing esthetic adhesive indirect restorations as resin composite/ceramic inlays, onlays and overlays.

The indications for either resin composite or ceramic indirect restorations are basically the same [23], showing better morphology in extensively destroyed teeth and greater resistance to wear [9], better marginal adaptation and longer longevity than that of direct restorations [29], and having a technique depending on the luting material in the context of an adequate adaptation of restoration [22, 26].

Considering the metallic alloys used in indirect restoration, high gold percentage alloys (70-75%) have resistance to corrosion, easy handling because of relatively low flow limit and possibility of proper alloy burnishing. With the increasing of gold cost, low gold percentage alloys were developed by increasing other metal contents as silver, and often are adequate substitutes for high gold percentage alloys regarding the aspects of marginal adaptation and biocompatibility; the small cost of low gold percentage alloys make them relatively popular in Dentistry [4].

The so-called alternative alloys also appeared in the context of reducing costs and are composed by non-precious metals as copper/aluminum alloys. Alternative alloys exhibit some unsatisfactory properties: difficult technique for casting and polishing; resistance to corrosion; color change; hardness; among others; thus, these alloys should be carefully used despite of its low cost [17, 30].

Considering all options of direct and indirect restorative materials available in daily clinical practice, many times, the selection of the material most adequate for each clinical case is difficult, mainly from the point of view of both the professional and patient. Accordingly, the aim of this research was two-fold: 1) to analyze through cross sectional study, which dental materials for direct (amalgam, resin composite and glass ionomer) and indirect restorations (gold, silver, and copper/aluminum alloys; laboratorial resins and ceramics) would be

more used by Brazilian dentists, in 2004; 2) to assess the main reasons for the use.

Material and methods

Questionnaires were sent to 486 Brazilian dentists from March to July of 2004, living in the same city of the undergraduates of both the School of Dentistry of Santa Fé do Sul Integrated School

(SP) and the Master Course in Operative Dentistry of São Leopoldo Mandic Center of Post-graduation (SP). The number of participants were determined based on the total number of dentists within each region (data obtained through the Brazilian Council of Dentistry website in March, 20, 2004). The number of participants included in the study according to the regions is seen below (table I).

Table I – Dentists' distribution according to the region of practice

Region	North	Northeast	Center-West	Southeast	South
Number	36	45	138	215	52

Data collection was obtained through a questionnaire composed by four multiple-choice questions on “Direct and indirect restorations: materials mostly commonly used by dentists”, which was answered by the professional interviewed.

The response variables were:

- 1) Direct restorative materials:
 - a) Metallic: amalgam
 - b) Esthetic: glass ionomer cement and resin composite
- 2) Indirect restorative materials:
 - a) Metallic: gold, silver and copper/aluminum alloys
 - b) Esthetic: laboratorial resins and ceramics
- 3) Reason for using the materials:
 - a) Low cost
 - b) Better clinical behavior
 - c) Esthetical demanding by the patient
 - d) Easy handling

Collected data were analyzed through grouping the results by similarity and distribution on Excel sheets (Microsoft, Redmond, Washington, USA). The study of the association among the variables disposed as tables was performed through Pearson's chi-squared test and Fisher test, if necessary. Global significance level was set at 5%.

Results and discussion

Through a questionnaire applied to dentists from different Brazilian regions, we attempted to obtain and overview about restorative dentistry of the beginning of the century in Brazil. The following variables were considered: material type used for direct restorations in posterior teeth (Q1 direct): metallic (amalgam – AAA) or esthetic (glass ionomer cement – GIC – or resin composite – RC) and for indirect restoration in posterior teeth (Q2 indirect): metallic (gold – G –, silver – D – and copper/aluminum alloys – Cu/Al) or esthetic (laboratorial resins – RES – and ceramics – CER). Also, variables regarding the reason for using these materials were analyzed (cheaper – CH –, clinical behavior – CB –, easy technique – ET – or patient's esthetical demand – PED). Thus, the materials used in either direct or indirect restorations were studied by statistically comparing the type (metallic and esthetic); within each type; and the reason for use (cost, clinical behavior, easy technique and patient's esthetical demand). The results regarding the material used in different restorative procedures at the different Brazilian countries are seen in tables II (direct restorations) and III (indirect restorations).

Table II – Direct restorative materials used in clinical procedures according to Brazilian regions

	Q1 direct				
	Metallic		Esthetic		
	AAA	Total	GIC	RC	Total
N	23	23 (63.9%)	-	13	13 (36.1%)
NE	29	29 (64.4%)	1	15	16 (35.6%)
S	19	19 (36.5%)	-	33	33 (63.5%)
SE	128	128 (59.5%)	6	81	87 (40.5%)
CW	76	76 (55.1%)	2	60	62 (44.9%)
Total %		275 (56.6%)			221 (43.4%)

Table III – Indirect restorative materials used in clinical procedures according to Brazilian regions

	Q2 indirect						
	Metallic				Esthetic		
	G	S	Cu/Al	Total	RES	CER	Total
N	1	4	16	21 (58.3%)	8	7	15 (41.7%)
NE	2	10	23	35 (77.8%)	4	6	10 (22.2%)
S	5	8	5	18 (34.6%)	20	14	34 (65.4%)
SE	16	44	69	129 (60%)	37	49	86 (40%)
CO	7	24	58	89 (64.5%)	25	24	49 (35.5%)
Total %				292 (60.1%)			194 (39.9%)

Direct restorations in posterior teeth

The analysis of percentage frequencies of metallic and esthetic materials did not show statistically significant differences comparing data among regions – North (63.9%/36.1%), Northeast (64.4%/35.6%), Southeast (59.5%/40.5%) and Center-West (55.1%/44.9%) –; and general sample (56.6%/43.4%). However, statistically significant differences were seen for data regarding South region (36.5%/63.5%) ($p < 0.05$).

After the analysis of the results of this present study, considering direct restorative material at Brazilian Market, the most used material in 2004 was dental amalgam (56%), when compared with resin composites and glass ionomer cements (43.4%), with statistically significant differences. This tendency was observed at all regions, except from South region, in which esthetic materials were the most employed.

Many authors have cited dental amalgam as the direct restorative material with longer durability; smaller wear, fracture, marginal leakage rates; easier handling, among others than that of esthetic materials [8, 24, 25, 32]. Accordingly, dental amalgam is very employed in posterior teeth despite of the tendency towards indicating esthetically more accepted materials, which is in agreement with the results of this present study. It is important to emphasize that, currently, esthetic materials tend to be increasingly used when compared with metallic materials, similar to which was verified by the South region of Brazil.

By considering the reasons for using amalgam, the main rationale behind its use was the clinical behavior (48.4%), followed by low cost (32.7%) and easy handling (18.9%). Only at Northeast region, the rationale behind the amalgam use was low cost (55.2%). These findings are in agreement

with those of Berry (1998) [5] in which amalgam cost is one of the items assuring the survival in restorative procedures. Similarly, Pucci *et al.* (1998) affirmed that amalgam should be the material of choice to construction of low cost direct restorations in posterior teeth, because the cost-benefit ratio of Class II amalgam restoration is greater than that of resin composite restoration [33]. The good clinical behavior of amalgam occurs because of the great capacity of supporting masticatory loads [13], longevity [33], easy handling and by the fact of exhibiting progressive self-sealing with low marginal leakage rates.

The study of esthetical materials used for direct restoration in posterior teeth, statistically significant differences were observed between glass ionomer cements (18%) and resin composites (82%); at North and South regions, glass ionomer cements were not cited. According the results of this present study, glass ionomer cements were little used in Brazil because of the esthetic outcome (100% of reports). However, a tendency towards making glass ionomer cement popular exists, because both the properties and possibilities of clinical indications have been improved, with interesting features, as adhesive properties and fluoride releasing [12, 19].

One great concern related with the employment of glass ionomer cements as restorative materials is the resistance to mechanical and erosive/abrasive forces, emphasizing that greatest differences exist in the mechanical properties among different glass ionomer cements commercially available [15]. Despite of this improvement, the inherent characteristics of these materials contraindicate their use for the restoration in posterior teeth, such as smaller tensile and compressive strengths than those of resin composites, and inferior esthetic outcome.

Despite the results of this present study, the resin composites have been very used for Brazilian

dentists and may become increasingly popular due to material. In most cases (95.7%), esthetics was the rationale behind resin composite use; only 3.8% of the dentists responded the clinical behavior of the material; and 0.5% cited easy handling. It is important noting that resin composite use probably increased in the last years, since the conduction of this present study, but resin composite still exhibit technical difficulties regarding its handling.

Both health/hygiene conditions and patients' motivation should be evaluated at the selection moment of the most adequate restorative material, since resin composite restorations tend to be more sensible at long term than dental amalgam restorations. Notwithstanding, by respecting the correct technique, the resin composites can show a durability similar to that of dental amalgams [21].

Indirect restorations in posterior teeth

The analysis of the percentage frequencies of metallic and esthetic materials did not presented statistically significant differences by comparing data among North (58.3%/41.7%), Southeast (60%/40%) and Center-West (64.5%/35.5%), and for general sample (60.1%/39.9%). Significant statistically differences were found at Northeast (77.8%/22.2%) and South regions (34.6%/65.4%).

After the analysis of the results of this present study, considering indirect restorative materials at Brazilian Market, in 2004, it was noted a predominance of metallic over esthetic materials. At Northeast region, this predominance was statistically significant (77.8%); at North, Southeast, and Center-West regions, no statistically differences were seen. At South region, a predominance of esthetic indirect restorative materials were seen.

Similarly to which was observed and considered the direct restorations, a tendency towards employing esthetic materials at the South region of Brazil was noted, demonstrating the dentist/patient's preferences by esthetic materials probably due to social-cultural issues.

The esthetic materials evaluated in this present study were laboratorial resins (48.5%) and ceramics (51.5%). Considering metallic materials, we evaluated Cu/Al (58.6%), Ag (30.8%) and Au alloys (10.6%), and the frequency of non-precious alloys was higher than that of gold alloys, except from South region, in which all alloys were used at similar frequencies.

The rationales behind the employment for metallic indirect materials were: clinical behavior (45.9%) and cost (44.2%), which were more significantly cited than easy handling (19.9%). The single rationale for using gold alloys were the clinical behavior, excepting from Southeast region, at which a small part of professions justifying their use by easy handling.

The high price of gold has forced the development of new low gold content. Some of them exhibited relatively low flowing; good ductility in the soften state, with easy burnishing; and good clinical behavior. A great concern on indirect restorations is marginal adaptation because of the most complex technique than that of direct restoration. Moreover, the adaptation of ceramic restorations is more difficult than that of indirect restoration made through resin composite stratification onto a dental cast previously obtained [2].

The use of silver alloy was more frequently employed (30.8%), justified by the clinical behavior of the material, excepting from the Southeast region, together with cost and easy handling. The material most used for metallic indirect restorations was Cu/Al alloy, justified by clinical behavior and cost.

On disadvantage of indirect restorations was both cost, greater number of appointments, and need of prosthetic technician [29]. Considering the esthetic indirect restorative materials, laboratorial resins were much employed (48.5%). According to Retief [34], polymerization contraction of these materials is minimum and compensated by the luting cement and hardness is similar to that of natural tooth [28].

At Southeast and Center-West regions, ceramics were the most used esthetic material. Ceramics have cost higher than that of laboratorial resins with higher hardness than that of dental structures which may result in wearing of opposing teeth [6, 27]. Notwithstanding, ceramics have excellent esthetic properties, biocompatibility, chemical stability, resistance to wear and oral cavity survival [36].

Generally, esthetic indirect restorative materials is justified by patients' esthetic demands followed by clinical behavior, cost and easy handling, which did not show statistically differences among each other. Thus, the results of this present study demonstrated that dental teaching should focus on all restorative materials, including metallic alloys and direct use of dental amalgam.

Conclusion

1) Direct restorations

- a) Frequency of metallic material use (56.6%) was greater than that of esthetic material use (43.4%);
- b) Concerning to metallic material types – 48.4% = clinical behavior; 32.7% = lower cost; 18.9% = easier handling;
- c) Concerning to esthetic material– 72% (RC) and 18% (GIC);
- d) Reason for esthetic use– 95.7% (patient's esthetic demand); 3.8% (clinical behavior) and 0.5% (easier handling).

2) Indirect restorations

- a) Frequency of metallic material use (60.1%) was greater than that of esthetic material (39.9%);
- b) Concerning to metallic material types – 58.6% (Cu + Al alloys), 30.8% (silver alloys) and 10.6% (gold alloy);
- c) Concerning to use of metallic material – 45.9% (clinical behavior), 44.2% (lower cost) and 9.9% (easier handling);
- d) Concerning to esthetic material types – 48.5% (laboratorial resins) and 51.5% (ceramics);
- e) Reason for esthetic use: 77.8% (patient's esthetic demand), 19.1% (clinical behavior), 2.1% (lower cost) and 1% (easier handling).

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