

Use of Standards in Papers Published in Dental Journals

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This study evaluated the use of standards in papers published in Brazilian and international dental journals. Papers published from January 2006 to December 2010 in the following journals were examined: Brazilian Dental Journal (BDJ), Brazilian Oral Research (BOR), Journal of Applied Oral Sciences (JAOS), Journal of Dental Research (JDR) and Dental Materials (DM). In addition to the title and type of study, issue, volume and year of publication, the following information was recorded from each paper: identification of any standard reported in the study; in case of no reported standard, indication if a standard could be used in the study. A total of 3,046 papers were examined, being 937 from DM, 936 from JDR, 489 from JAOS, 348 from BDJ, and 336 from BOR. Considering the papers that could use some standard, DM showed the highest percentage (24.9%) of reporting standards/paper, followed by JAOS (10.3%), BOR (10.1%), BDJ (6.3%) and JDR (2.4%), meaning for example that, from 936 papers examined from the JDR, 623 could use some standard but only 15 papers reported them. From all papers examined, 309 (10.1%) reported using some standard. The ISO standards were mostly reported (57.8%), followed by ASTM standards (23.7%) and 74 (18.5%) standards from other international organizations (e.g. ADA and CIE). Despite of the high impact factors of the selected dental journals, their published papers could use standards more often. This study should assist journal editors to encourage authors to consult and refer to available standards to support the scientific papers.

Key Words: Standards, dentistry, scientific papers, dental journal.

INTRODUCTION

International standards give state of the art specifications for products, services and good practice, helping making industry more efficient and effective. Developed through global consensus, they help to break down barriers to international trade (1).

Standards serve a variety of market-perfecting purposes. They provide the basis for comparison of products and establish consistent terminologies through standard definitions, measures, and test procedures. They also promote compatibility of products used in systems, thereby reducing the ranges of variety of products. Not only standards assure desired qualities and performance levels, but they also reduce low quality by providing consumers with an easy check on individual producer quality claims, thereby increasing consumer welfare. As a result, standards can enhance the overall image of industry. The use of standards increases buyer

confidence about product quality and in turn may very well increase overall demand for the product, reflecting buyer preference regarding quality. Standards provide for transfer of technologies throughout industry and facilitate introduction of innovation by reducing market and technical risks. They provide the industry with an important marketing tool (2).

The leading current standards are from the *International Standards Organization* (ISO) and *ASTM International*, known prior to 2001 as the *American Society for Testing and Materials* (ASTM). The ASTM was formed in 1898 by chemists and engineers from the Pennsylvania Railroad. At the time of its establishment, the organization was known as the American Section of the *International Association for Testing and Materials*. Today, the ASTM has more than 30,000 members from 135 Countries (3,4).

The ISO is the world largest standards developing organization. It was born from the union of two

organizations - the ISA (*International Federation of the National Standardizing Associations*), established in New York in 1926, and the UNSCC (*United Nations Standards Coordinating Committee*), established in 1944. Aiming “to facilitate the international coordination and unification of industrial standards”, the new organization, ISO, officially began operations on 23 February 1947. Since then, ISO has published more than 19,000 International Standards, ranging from standards for activities such as agriculture and construction, through mechanical engineering, to medical and dental devices, to the newest information technology developments. Today ISO has members from more than 160 countries and more than 150 people work full time for ISO’s Central Secretariat in Geneva, Switzerland (3,4).

In addition to ISO and ASTM standards, the *American Dental Association* (ADA), the accredited dental standards body of the *American National Standards Institute* (ANSI), also publishes dental standards (3,4).

The ISO dental standards are overseen by the ISO Technical Committee (TC), namely ISO/TC106, which has published more than 150 dental standards. This is administered by a Secretariat through its standards organization (SCC). TC106 is currently divided into seven Sub-Committees (SC), each with their own Secretariat, that are further divided into convened Working Groups (WG), which produce drafts of one or more standard documents. When these drafts reach a definitive status they are released for voting and comments by the national bodies represented in the seven SC of the TC106 (3,4): SC 1: Filling and restorative materials; SC 2: Prosthodontic materials; SC 3: Terminology; SC 4: Dental instruments; SC 6: Dental equipment; SC 7: Oral care products; SC 8: Dental implants.

With the globalization of knowledge, it is essential to use standards to perform scientific studies, standardizing technical-scientific methodologies and terminology and, therefore, the criteria to allow for comparison between study results. Thus, the objective of the present study was to evaluate the use of standards in papers published in Brazilian and international dental journals during the last 5 years, testing the hypothesis that standards are underused in published dental papers.

MATERIAL AND METHODS

Two trained examiners evaluated papers published

from January 2006 to December 2010 (5 years) in the following journals: Brazilian Dental Journal (Braz Dent J); Brazilian Oral Research (Braz Oral Res); Journal of Applied Oral Sciences (J Appl Oral Sci), Journal of Dental Research (J Dent Res) and Dental Materials - Journal for Oral and Craniofacial Biomaterials Sciences (Dent Mater). In addition to the title and the type of study, the issue, the volume and the year of publication, the following information were recorded from each paper: identification of any standard reported in the study; in case of no reported standard, indication if a standard could be used in the study (Table 1).

The ISO and ASTM standards related to the published papers were recorded. The percentage of each examined parameter was calculated.

RESULTS

A total of 3,046 papers were examined: 937 from the Dent Mater, 936 from the J Dent Res, 489 from the J Appl Oral Sci, 348 from the Braz Dent J, and 336 from the Braz Oral Res (Table 2). Considering the papers that could use some standard, Dent Mater showed the highest percentage (24.9%) of papers that actually used them, followed by J Appl Oral Sci (10.3%), Braz Oral Res (10.1%), Braz Dent J (6.3%) and J Dent Res (2.4%), which means for example that, from 936 papers examined (n) from the J Dent Res, 623 (np) could use some standard, but only 15 (nN) papers reported the use of at least one standard (Table 2).

From the 3,046 papers examined, 309 (10.1%) reported the use of some standard. The ISO standards were most frequently reported (57.8%), followed by 95 ASTM standards (23.7%) and 74 standards (18.5%) from other international organizations such as ADA and CIE (*International Commission on Illumination*). Yet, all of these 74 standards have equivalent standards from ISO or ASTM that could be reported as an alternative.

The most commonly reported standards are summarized in Table 3. Other relevant dental standards are presented in Table 4.

DISCUSSION

Standards are important tools to scientific research, including dental studies because they describe relevant parameters that substantiate reliable scientific work.

According to the study inclusion criteria, from

the 2,393 published papers that could use scientific standards, only 309 papers used at least one of them. This implies that 87% (n=2,084) of the published papers did not use these valuable documents. Despite the relevance of this finding, it seems to be unrelated to the journal's impact factor, considering that *J Dent Res*, the highest impact factor in the dental literature, presented the worst standard/paper ratio (4.8%). *Dent Mater* reported the largest number of standards (n=290) that were used for 212 published papers. Yet, it accounts for only 24% (n=212) of the 850 published papers that could use some standard (np) during the evaluated period (Table 2).

From the three Brazilian journals evaluated, the *J Appl Oral Sci* showed the highest (12.2%) standard/paper ratio, followed by the *Braz Oral Res* (8%) and the *Braz Dent J* (6.1%).

Considering the study design (type of study), the great majority of the papers were original research,

irrespective of the journal evaluated, meaning, from the 3,046 papers, 72.2% (n=2,200) were original research, 18.4% (n=560) were clinical trials, 7.1% (n=217) were literature reviews and 2.3% (n=69) were case reports. This data is closely related to the use of standards since the papers (nN) that report at least one standard (n=309), 96.8% (n=299) were original research, 2.9% (n=9) were literature reviews and only one (0.3%) clinical trial (Table 2). Standards were absolutely not reported in case reports, irrespective of the evaluated journal.

The most commonly reported standards refer to ceramics and polymers, such as: the ISO 4049 (Dentistry - Polymer-based restorative materials) reported in 44 papers and the ISO 6872 (Dentistry - Ceramic materials) reported in 19 papers (Table 3). This finding may represent the researchers' concern to establish standardization criteria for the work within these biomaterials areas. Yet, the majority of papers that had a chance to report at least one standard (np=2,393) did not (2,084). Some of the ISO standards that could be reported in these studies are listed in Table 4.

Possible explanations for the low standard/paper ratio are the need of ordering such documents, which may influence researchers and authors to use other published papers as reference for the research methods, and the assumption that standards are not a consensus among authors and reviewers as a standardization parameter.

It is important to mention that the standards used to substantiate papers are sources of information and serve as scientific references for the work. Therefore, they should be properly listed in the references, which was not the case in many of the published papers.

Table 1. Form to collect information from each scientific paper evaluated.

Journal name, issue, volume and year of publication:

Paper title:

Type of study*:

Did the paper use any standard?

() Yes Standard number and title?

() No Could it use any standard?

If yes, what standard number and title?

*1: original research; 2: clinical trial; 3: literature review; and 4: case report.

Table 2. Quantitative information on the number of papers examined (n), type of study*, number of papers that could use some standard (np), number of papers that reported the use of at least one standard (nN), total number of standards used in the examined papers (nNt) and the international organization from where they were published (ISO, ASTM or other).

Journal	n	Type of study*				np	nN	nNt			
		1	2	3	4			nNt	ISO	ASTM	Other
Dent Mater	937	876	32	27	2	850	212	290	162	75	55
J Dent Res	936	533	266	136	1	623	15	16	9	7	0
J Appl Oral Sci	489	313	125	28	23	370	38	39	26	3	10
Braz Dent J	348	243	57	5	43	303	19	23	18	3	2
Braz Oral Res	336	235	80	21	0	247	25	33	17	9	7
Total	3,046	2,200	560	217	69	2,393	309	401	232	95	74

*1: original research; 2: clinical trial; 3: literature review; and 4: case report.

Table 3. The most commonly reported standards presented by the identification number (ID) and describing title, the number of papers that cited the standard (nS), and the number of papers that could cite the standard, including the ones that actually cited it (ncS).

Standard ID	Standard title	nS	ncS
ISO 4049:2009	Dentistry - Polymer-based restorative materials	44	214
ISO 6872:2008	Dentistry - Ceramic materials	19	119
ISO 1567	Dentistry - Denture base polymers	18	18
CIE 15	Colorimetry	18	18
ISO 10993	Biological evaluation of medical devices sample preparation and reference materials	17	233
ISO/TS 11405:2003	Dental materials - Testing of adhesion to tooth structure	15	177
ISO 10477:2004	Dentistry - Polymer-based crown and bridge materials	10	11
ADA 27	Resin-based filling materials: 1993	10	10
ISO 9917-1:2007	Dentistry - Water-based cements - Part 1: Powder/liquid acid-base cements	9	51
ISO/DIS 6876	Dentistry - Root canal sealing materials	7	37
ISO 9693:1999	Metal-ceramic dental restorative systems	7	13
ISO/TR 14569- 1:2007	Dental materials - Guidance on testing of wear - Part 1: Wear by tooth brushing	7	13
ASTM C 1161- 02c(2008)	Standard test method for flexural strength of advanced ceramics at ambient temperature	7	7
ISO 10526	Standard illuminants for colorimetry	6	9
ASTM C 1322	Standard practice for fractography characterization of fracture origins in advanced ceramics	6	6
ASTM D 2240	Standard test method for rubber property	6	6
ADA 57	Endodontic sealing material: 2000	6	6
ISO 7491:2000	Dental materials - Determination of color stability	5	8
ISO 10271:2001	Dental metallic materials - Corrosion test methods	4	15
ISO 4823:2000	Dentistry - Elastomeric impression materials	4	14
ISO 7405	Evaluation of biocompatibility devices used in dentistry	4	4
ASTM F 67	Standard specification for unalloyed titanium, for surgical implant applications	4	4
ASTM C 1499	Standard test method for monotonic equibiaxial flexural strength of advanced ceramics at ambient temperature	4	4
ASTM F 394-78	Standard test method for biaxial flexure strength (modulus of rupture) of ceramic substrates	4	4
ASTM E 399	Standard test method for linear-elastic plane-strain fracture toughness K_{IC} of metallic materials	4	4
ASTM D 790-03	Standard test methods for flexural properties of unreinforced and reinforced plastic and electrical	4	4
ISO 9917-2:2010	Dentistry - Water-based cements - Part 2: Resin-modified cements	3	15
ISO 15841:2006	Dentistry - Wires for use in Orthodontics	3	9
ISO/TS 14569- 2:2001	Dental Materials - Guidance on testing of wear - part 2: wear by two and/or three body contact	3	3
ASTM E 647	Standard test method for measurement of fatigue crack growth rates	3	3
ASTM C 1239-07	Standard practice for reporting uniaxial strength data and estimating weibull distribution parameters for advanced ceramics	3	3
ASTM 308-90	Standard practice for computing the colors of objects by using the CIE system	3	3

Table 4. Other relevant reported ISO standards presented by the identification number (ID) and describing title, the number of papers that cited the standard (nS) and the number of papers that could cite the standard, including the ones that actually cited it (ncS).

ISO Standard ID	ISO Standard title	nS	ncS
ISO 10650-1:2004	Dentistry - power polymerization activators - Part 1: quartz tungsten halogen lamps	2	7
ISO 7489	Dental glass polyalkenoate cements	2	2
ISO 37:1994	Rubber, vulcanized or thermoplastic - determination of tensile stress-strain properties	2	2
ISO 178	Plastics - determination of flexural properties	2	2
ISO 1562	Dentistry - casting gold alloys	2	2
ISO 1559	Dental materials - alloys for dental amalgam	2	2
ISO 6344-1	Coated abrasives - grain size analysis	2	2
ISO 14801	Dentistry - implants - dynamic fatigue test for endosseous dental implants	2	2
ISO/NP 16506	Dentistry - polymer-based luting materials containing adhesive components	1	18
ISO 6877:2006	Dentistry - root-canal obturating points	1	11
ISO 3630-1:2008	Dentistry- Root-canal instruments - Part 1: general requirements and test methods	1	9
ISO 5832-3	Implants for surgery - metallic materials	1	9
ISO 1563:1990	Dental alginate impression material	1	3
ISO 3665	Photography - intra-oral dental radiographic film	1	2
ISO 1984	Test conditions for manually controlled milling machines with table of fixed height - testing of the accuracy	1	2
ISO 15912:2006	Dentistry - casting investments and refractory die materials	1	1
ISO 14577	Metallic materials - harness test	1	1
ISO 2039-1	Plastics - determination of hardness - Part 1: ball indentation method	1	1
ISO 6507-3	Metallic materials - vickers hardness test.	1	1
ISO 5799	Photography - direct-exposing medical and dental radiographic film/process systems	1	1
ISO 16744	Dentistry - base metal materials for fixed dental restorations	1	1
ISO 13356	Implants for surgery - ceramic materials based on yttria-stabilized tetragonal zirconia	1	1
ISO/AWI 17304	Dentistry - polymerization shrinkage of filling materials		51
ISO 11133-1:2009	Microbiology of food and animal feeding stuffs - guidelines on preparation and production of culture media		40
ISO 24597	Microbeam analysis - scanning electron microscopy - methods of evaluating image sharpness		35
ISO 3630-5	Dentistry - root-canal instruments - Part 5: shaping and cleaning instruments		24
ISO/ TS 22911:2005	Dentistry - preclinical evaluation of dental implant systems - animal test methods		21
ISO 16408:2004	Dentistry - oral hygiene products - oral rinses		15
ISO 28399:2011	Dentistry - products for external tooth bleaching		15
ISO 3107:2011	Dentistry - zinc oxide/eugenol cements and zinc oxide/non-eugenol cements		14
ISO 11609:2010	Dentistry – dentifrices - requirements, test methods and marking		14
ISO 27020:2010	Dentistry - brackets and tubes for use in Orthodontics		12
ISO / NP 16202-1	Dentistry - classification and codification of oral anomalies - Part 1: structure of classification		12
ISO 20776-2	Clinical laboratory testing in vitro diagnostic test systems		12
ISO 22674:2006	Dentistry - metallic materials for fixed and removable restorations and appliances		11
ISO 6874:2005	Dentistry - polymer-based pit and fissure sealants		10

Despite of the high impact factors of the selected Brazilian and international dental journals, the published papers should use standards more often, which confirms the study hypothesis. As the standards substantiate scientific studies and facilitate data comparison among reports, the results of the present systematic review should assist journal editors and reviewers to encourage authors to consult and refer to available standards to support scientific studies and papers.

RESUMO

Este estudo avaliou o uso de normas científicas em artigos de Odontologia publicados em periódicos brasileiros e internacionais. Trabalhos publicados de janeiro de 2006 a dezembro de 2010 foram examinados nas seguintes revistas: *Brazilian Dental Journal* (BDJ), *Brazilian Oral Research* (BOR); *Journal of Applied Oral Science* (JAOS), *Journal of Dental Research* (JDR) e *Dental Materials* (DM). Além do título, tipo de estudo, volume e ano de publicação, as seguintes informações foram registradas a partir de cada artigo: identificação de normas relatadas no estudo; em caso negativo, relatar se alguma norma poderia ser aplicada no estudo. Um total de 3.046 artigos foi examinado como segue: 937 no DM, 936 no JDR, 489 no JAOS, 348 BDJ e 336 no BOR. Considerando os artigos que poderiam usar alguma norma, o DM apresentou o maior percentual (24,9%) de normas/artigos relatados, seguido pelo JAOS (10,3%), BOR (10,1%), BDJ (6,3%) e JDR (2,4%), o que significa que de 936 trabalhos analisados do JDR, 623 poderiam ter usado alguma norma, mas apenas 15 relataram o uso. De todos os trabalhos examinados, 309 (10,1%) estudos relataram alguma norma. As normas ISO foram relatadas na maior parte (57,8%), seguido pelas normas ASTM (23,7%) e 74 (18,5%) feitas por outras organizações internacionais (por exemplo, ADA e CIE). Apesar do alto fator de impacto dos periódicos selecionados, seus artigos publicados poderiam utilizar as normas com maior frequência. Este estudo deve alertar os editores de periódicos a incentivar os autores a consultar as normas disponíveis para apoiar a metodologia dos trabalhos científicos.

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