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# Role of Centella Asiatica Extract in Thermal Burns Healing

Chinthireddy Pranaypal<sup>1</sup>, Ravi Kumar Chittoria<sup>2</sup>, Neljo Thomas<sup>3</sup>

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**Abstract**

Currently, several medicinal plants have been integrated into the health care system to aid in wound healing. Centella asiatica has been used in traditional medicine because of its ability to heal wounds and prevent scarring. This article is about the role of Centella asiatica (C. asiatica) in thermal burns healing.

**Keywords:** Centella asiatica, thermal burns, scar

**Introduction**

Wound healing process occurs with almost all medical treatments. Natural substances contained in herbs and plants have properties that assist in and enhance the wound healing process with its antioxidant, anti-inflammatory and antibacterial properties.<sup>1,2</sup> Epithelialization is the natural act of healing dermal tissue resulting in minimal or no scarring.<sup>5</sup> In most cases, scars occur if the depth reaches the dermis layer. When hypertrophic scar or keloid develops, it may induce itching, pain and even scar contracture.<sup>3</sup> A lot of agents have been used to improve scars such as onion extract, resveratrol in grape's skin, curcumin and Centella. The role of Centella asiatica extract in thermal burns healing is due to its anti-oxidant and anti-

inflammatory and collagen remodelling property.<sup>4</sup>

**Materials and Methods**

This study was conducted in tertiary care centre in department of plastic surgery after getting the department ethical committee approval. Informed consent was obtained for examination and clinical photography. A 16 year old female with 2nd degree and 3rd degree burns involving the both lower limb from ankle to thigh (Figure 1) was admitted and given regular topical application (Figure 2) of Centella preparation (Figure 3).

**Results**

The wound had healed with adequate patient



Fig. 1: Thermal Burns injury before treatment



Fig. 2: Application of Centella asiatica extract on thermal burns injury

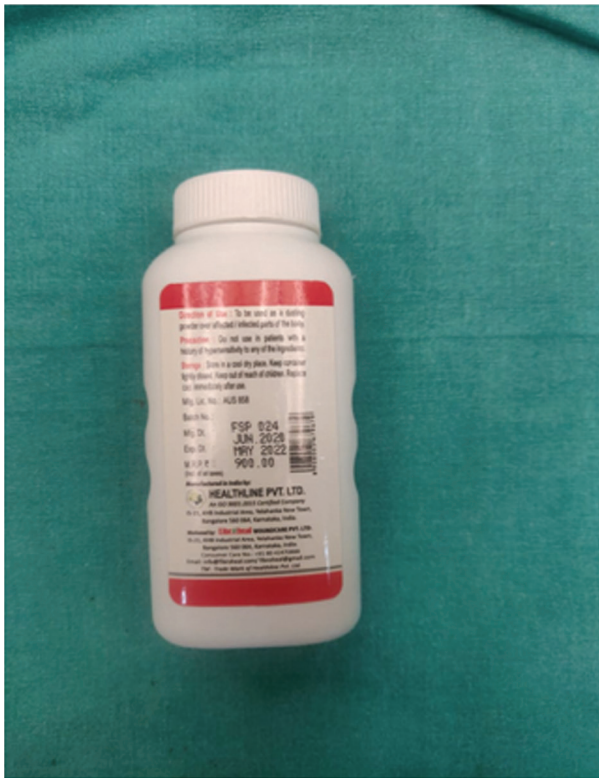


Fig. 3: Centella Asiatica preparation

satisfaction with a minimal scar formation (Figure 4).

## Discussion

Centella asiatica, also commonly known as Gotukola, is a small plant that belongs to the family Acanthaceae.<sup>4</sup> The active compounds of *C. asiatica* responsible for thermal burns healing are pentacyclic triterpenes, including asiaticoside and madecassoside. In vitro studies demonstrated that asiaticoside decreases



Fig. 4: Thermal Burns wound after skin grafting after wound bed preparation with Centella extract

fibroblast proliferation in a dose-related manner and reduces the expression of both TGF- $\beta$  I and TGF- $\beta$  II at the transcriptional and translational level.<sup>10</sup> Asiaticoside also slows down scar formation by increasing the activity process of SMAD 7 which is a negative regulator of TGF- $\beta$  signalling.<sup>11</sup> The other active composition, madecassoside acts by inhibiting the migration of fibroblasts.<sup>12</sup> Both active chemical substances promote *C. asiatica* to induce

fibroblast proliferation and collagen synthesis. It involves the improvement of the tensile strength of newly formed skin and maturation of the scar by the production of type I collagen.<sup>7</sup>

It is mostly often used for wound healing, treating mental fatigue, bronchitis, asthma, dysentery, kidney trouble, urethritis, antiallergic and anticancer purposes and even for blood pressure. It is rarely used for memory improvement with not much use. Use of Centella extract for 4-8 weeks seems to improve blood circulation and reduce swelling in people with varicose veins.

It has low adherence to the wound bed (figure 2). It doesn't have skin irritating potential and has no effects on serum biochemical profile when applied dermally. There is limited or no scar formation.<sup>8,9</sup>

It can't be used in conditions like damage to skin caused by radiation therapy. It is safe when used for up to 10 weeks. It might cause itchiness and redness if used for longer period. Contact dermatitis<sup>13,14</sup> can occur sometimes. It also might cause liver damage. Especially, people who already have a liver disease should avoid using Centella asiatica since it might make liver problems worse.

## Conclusion

The effect of Centella cream on scar development of the thermal burns may be attainable in terms of better pigmentation. By means of objective measurements and longer follow-up times, Centella cream may prove to be an alternative to prevent the formation of hypertrophic scar.

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# Biological Scaffolds: A Review

Sowmya Ramgopal<sup>1</sup>, Ravi Kumar Chittoria<sup>2</sup>, Neljo Thomas<sup>3</sup>

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**Abstract**

Biological scaffolds have been used in various fields to augment tissue repair and regeneration. It is of various types and have been of its own advantages and disadvantages. In this article we discuss about the biological scaffolds and its applications.

**Keywords:** Biological Scaffolds; Breast Surgery; Abdominal Surgery.

**Introduction**

Biological scaffold is defined as a biomaterial structure that serves as a substrate and guide for tissue repair and regeneration. With advancements in biological scaffolds have become an important tenet to regenerative medicine in plastic surgery. Not only do biological scaffolds provide a structural support but they also, through their inherent properties promote cellular proliferation and differentiation. Biological scaffolds are aligned with our broader objective of making interventions as biocompatible as possible.

**History**

Since its emergence in the mid-1980s, tissue engineering has continued to evolve as an exciting and multidisciplinary field aiming to develop biological substitutes to restore, replace or

regenerate defective tissues. Cells, scaffolds and growth stimulating signals are generally referred to as the tissue engineering triad, the key components of engineered tissues.

**Mechanism of Action**

By virtue of their inherent mechanical, biological and architectural properties biological scaffolds assist in tissue engineering and regeneration by:

1. Providing a support matching the original extracellular material in terms of its mechanical properties.
2. Promote specific cellular lineage regeneration and differentiation by using the principle of durotaxis.
3. Scaffolds can, for example, be engineered to contain adhesion ligands establishing topography and promote correct cell

deposition and alignment, or biological cues such as growth factors, nucleic acids, and cytokines that promote tissue proliferation

### ***Advantages of Biological Scaffolds in Tissue Engineering –***

#### **a. In Skin Repair**

Scaffolds are effective when they inhibit wound contraction and its sequelae, scar formation, and their effectiveness can be modified by varying their pore structure, degradation rate, and surface biochemistry.

Hence, they have been used in the treatment of partial and full thickness wounds, pressure ulcers, diabetic foot ulcers, chronic vascular ulcers, surgical wounds, venous lower extremity ulcers, and burns.

#### **b. In Breast Surgery**

Acellular dermal matrix improves surgical and aesthetic outcomes by providing tissue support to the mastectomy skin flaps. It can minimize periprosthetic fibrosis and appears to lessen the inflammatory response associated with prosthetic devices.<sup>7</sup> Use of acellular dermal matrix in the setting of radiation therapy is useful in the short-term but may not ameliorate soft tissue related morbidities in the long term.

#### **c. In Abdominal Surgeries**

The use of biological meshes in the repair of hernias is a matter of debate, which can be summarised by the following table.

### ***Disadvantages***

PROS	CONS
Carries lower risk of infection.	Biological meshes are expensive
Can be used in the management of Parastomal Hernia <sup>2</sup>	Recurrence rates are relatively more <sup>8</sup>
Can be used in the management of Hiatal Hernias.	Long term results are not favourable as increased rates of abdominal wall laxity <sup>8</sup>
1. Standardization for the safety assessment of the cell-scaffold construct is very difficult.	matrix for complicated ventral hernia repair: does technique affect outcomes? J Am Coll Surg. 2007 Nov;205(5):654-60.
2. Maintaining neovascularisation in the in vitro setting is a challenge. It is virtually impossible to expect the neovascularization through out a cell-scaffold construct in the case of in vitro tissue engineering.	2. Lo Menzo E, Martinez JM, Spector SA, Iglesias A, Degennaro V, Cappellani A. Use of biologic mesh for a complicated paracolostomy hernia. Am J Surg. 2008 Nov;196(5):715-9.
3. Ethical Issues – The main source of the biological scaffolds is from the connective tissue of lower mammals.	3. Oelschlager BK, Pellegrini CA, Hunter J, Soper N, Brunt M, Sheppard B, Jobe B, Polissar N, Mitsumori L, Nelson J, Swanstrom L. Biologic prosthesis reduces recurrence after laparoscopic paraesophageal hernia repair: a multicenter, prospective, randomized trial. Ann Surg. 2006 Oct;244(4):481-90.
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### ***Complications***

These biologic materials are typically allogeneic or xenogeneic in origin and are derived from tissues such as small intestine, urinary bladder, dermis, and pericardium of lower mammals.

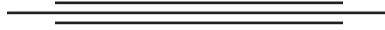
The innate and acquired host immune response to these biological scaffolds has been largely unexplored.

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# Finite Element Analysis and its Implementation in Surgery: Literature Review

Debolina Pal<sup>1</sup>, Ravi Kumar Chittoria<sup>2</sup>, Neljo Thomas<sup>3</sup>

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## Abstract

Biomechanics refers to the study of structure and function of biological systems, using methods obtained from mechanics, which is concerned with the effects that forces have on the motion of bodies. Recently, there has been a development of implementation of various virtual studies in the field of biomechanics. One such remarkable development is the technology of finite element analysis (FEA). Through this technology, complex mechanical systems in human body, which otherwise are difficult to understand in vivo, could be studied using mathematical conversion of the geometrical model in question. This has its implications in the field of trauma surgery, especially oral and maxillofacial surgery, reconstructive surgery and implantology. The available literature indicates FEA to be an important instrument in understanding and reconstructing complex human mechanical systems.

**Keywords:** Finite Element Analysis (Fea); Maxillofacial Surgery; Traumatology; Reconstructive Surgery; Implantology.

## Introduction

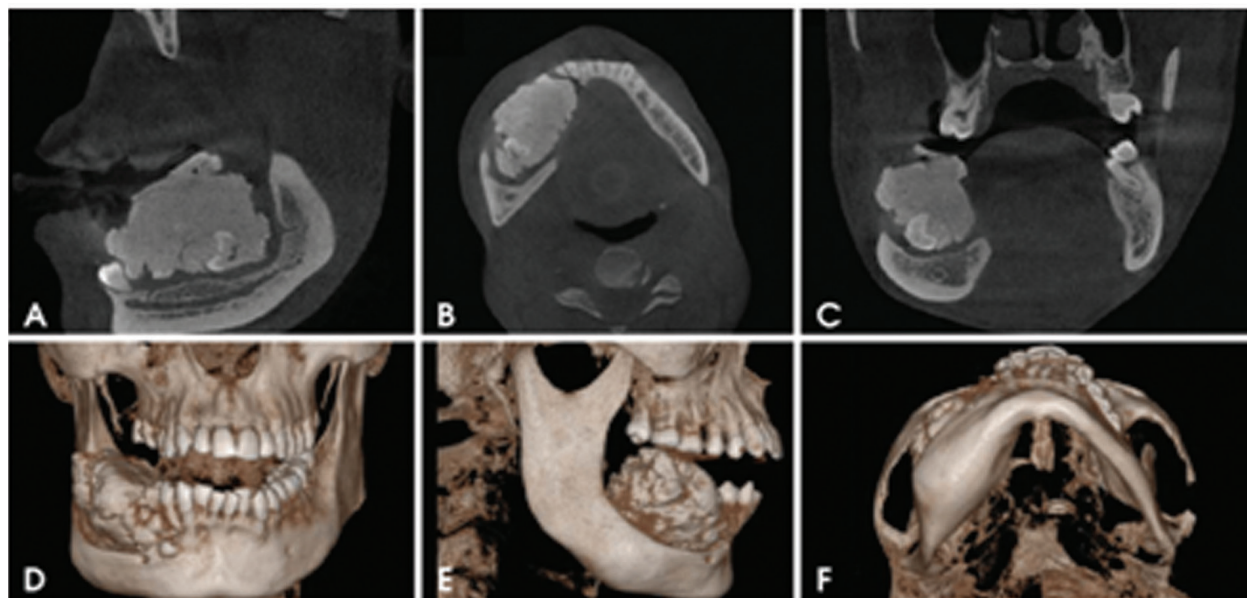
Understanding stresses and strains in living tissues, are required in the field of surgery. Due to its complex nature and difficulty in measuring the parameters in vivo, the actual mechanisms of such biomechanics have not been fully understood. Finite element analysis (FEA) is a computer aided mathematical technique that analyses stresses and strains in complex mechanical systems.<sup>1</sup>

The finite element method of stress analysis (FEM) functions by deducing numerical solutions to the abstract equations of calculus that predict the response of physical systems subjected to external influences.<sup>2,3</sup> With the increasing availability and

decreasing costs of suitable software and hardware for virtual analyses makes wider applicability of this technology possible. Finite element analysis has been used in fields such as trauma surgery, especially oral and maxillofacial surgery, reconstructive surgery and implantology. In this article, we intend to review the available literature on FEA and discuss regarding the method, applications and limitations and the various research on application of FEA in modern surgery.

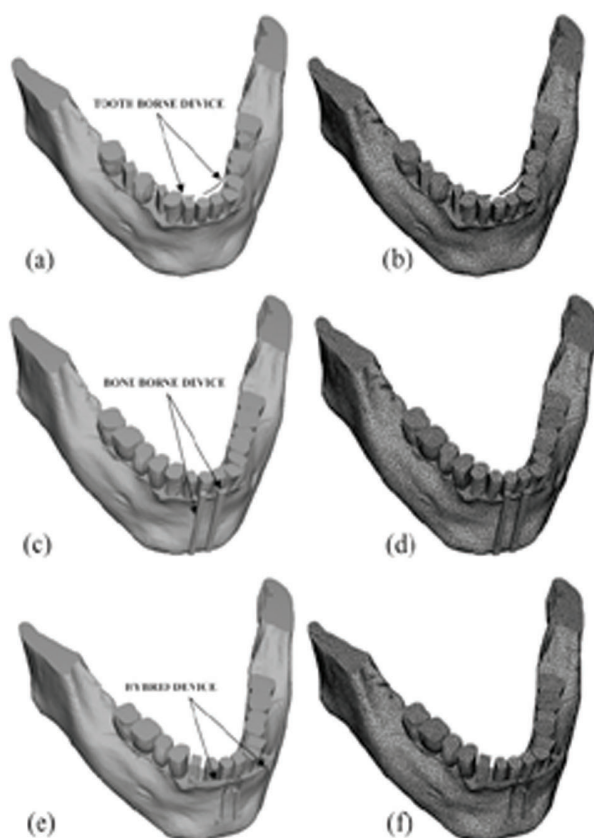
## Materials and Methods

Research articles based on the subject of finite element analysis from reputed journals were



**Fig. 1:** Cone Beam Computed Tomography (CBCT) of human mandible.

**Source:** Bagewadi, Shivanand & Kukreja, Rahul & GN, Suma & Yadav, Bhawna Yadav & Sharma, Havi. (2015). Unusually large erupted complex odontoma: A rare case report. *Imaging science in dentistry*. 45. 49-54.



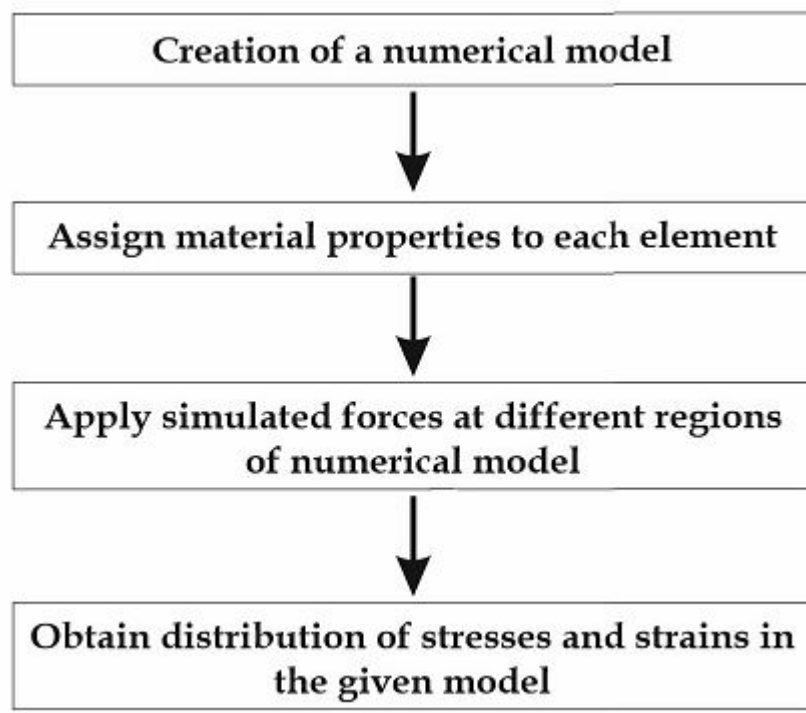
**Fig. 2:** Computer-aided design model of human mandible

**Source:** Boccaccio, Antonio & Cozzani, Mauro & Pappalettere, Carmine. (2011). Analysis of the performance of different orthodontic devices for mandibular symphyseal distraction osteogenesis. *European journal of orthodontics*. 33. 113-20.

thoroughly reviewed. Literature from principal fields associated with utilization of FEA, including trauma surgery, especially oral and maxillofacial surgery, orthognathic surgery, reconstructive surgery and implantology were studied and included in this article. The essence of application of FEA in the above mentioned fields were comprehended and presented in a concise manner in this article.

## Discussion

Finite element analysis is an emerging technology that deals with simplification of understanding complex mechanical. The first step in FEA is creation of a three-dimensional model of the part of human body in question which would form the basis for creation of a numerical model of the same. This can be achieved using cone beam computed tomography (CBCT) (figure 1), microtomography, intra- and extraoral scanners or computer-aided design (CAD) software (figure 2).<sup>4</sup> Following creation of a numerical model, discretization is done. Discretization refers to division of the model into numerous simple elements (finite elements), that are connected at a common nodal point. Material properties such as Young's modulus (E) or Poissons's ratio are then determined for each of the elements. Following these steps, we can determine the distribution of stresses and strains in the given model by application of simulated forces on various regions of the numerical model (figure 3).



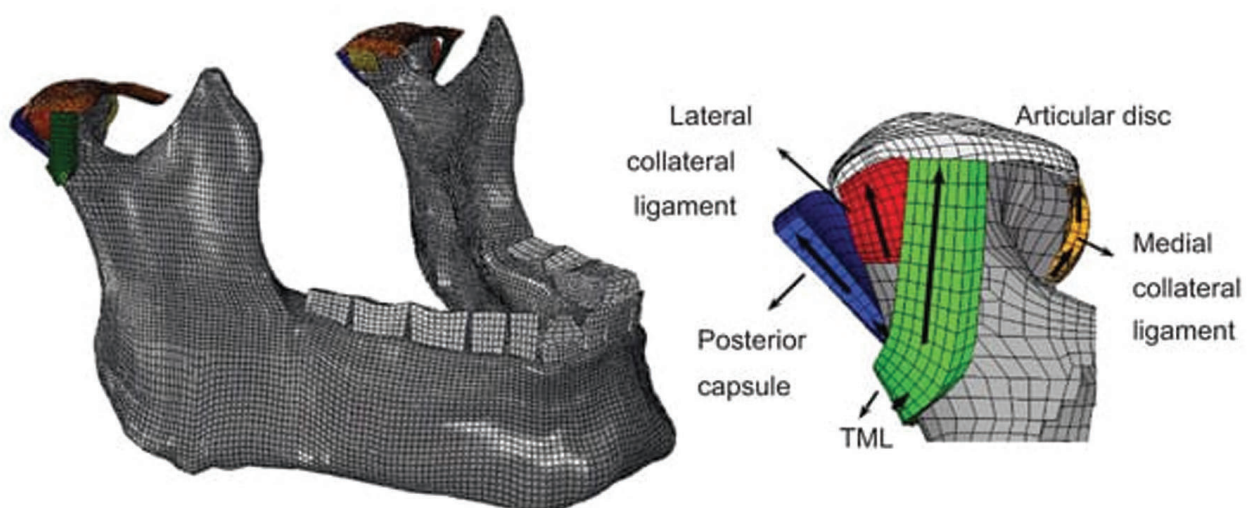
### Methodology of Finite Element Analysis Concept

It is challenging and ethically impractical to determine the consequences of facial trauma and its causes. In the field of trauma surgery, finite element analysis helps in determining the regions of skull that are particularly prone to fractures by precise mapping of stress distribution following trauma.<sup>5</sup> As a result of this there is greater understanding of the biomechanics which in turn helps in surgical planning.

Orthognathic surgery refers to correction of jaw bone irregularities and realignment of jaws

with teeth to improve its function and probably facial appearance. An important determinant of successful outcome in orthognathic surgery is the selection of appropriate bridging elements and FEA has been used to compare the stability of bridging the bony segments with various fixation systems in bilateral sagittal split osteotomy procedure.<sup>6-11</sup>

Finite element analysis can also be used to reconstruct excised portions, for instance excision of jaw bone due to oral malignancy. Using the technology of FEA, studies have been done to compare the level of stress at bone graft interface



**Fig. 3:** Finite element analysis of mandible and temporomandibular joint

**Source:** Commisso, Maria & Reina, J. & Mayo, Juana. (2014). A study of the temporomandibular joint during bruxism. International journal of oral science. 6. 10.1038/ijos.2014.4.



to identify the most suitable type of transplant in a given condition.<sup>12</sup> In a different context of reconstructive surgery, Kuwahara et al utilised the technology of FEA in reconstruction of ear in a case of cryptotia (auricular muscle abnormality that causes the superior and posterior auricular area to be buried under the temporal skin) to compare the Square flap method and the Cat's Ear flap method for reconstruction of cryptotia. Finite element analysis of these two historical procedures for cryptotia revealed how the dynamics of each procedure led to morphological changes that induced extrusion of the buried helix.<sup>13</sup>

Though FEA has been used and appreciated in the aforementioned fields, it carries its drawbacks. The major disadvantage of FEA are its simplifications and assumptions. Attempts to improve geometrical accuracy could be made but only at the cost of time and resources.<sup>4</sup>

## Conclusion

Following thorough review of available literature on finite element analysis, we conclude that FEA serves as an innovative and useful tool in understanding of various biomechanical intricacies in a simplified manner and allows practical application of the same in various fields of surgery. Current literature indicates its popular application in maxillofacial surgery but this technology carries potential for wider applicability. Further studies are to be carried out to explore the potential of FEA in the field of surgery.

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### Standard journal article

[1] Flink H, Tegelberg Å, Thörn M, Lagerlöf F. Effect of oral iron supplementation on unstimulated salivary flow rate: A randomized, double-blind, placebo-controlled trial. *J Oral Pathol Med* 2006; 35: 540-7.

[2] Twetman S, Axelsson S, Dahlgren H, Holm AK, Källestål C, Lagerlöf F, *et al.* Caries-preventive effect of fluoride toothpaste: A systematic review. *Acta Odontol Scand* 2003; 61: 347-55.

### Article in supplement or special issue

[3] Fleischer W, Reimer K. Povidone iodine antiseptics. State of the art. *Dermatology* 1997; 195 Suppl 2: 3-9.

### Corporate (collective) author

[4] American Academy of Periodontology. Sonic and ultrasonic scalers in periodontics. *J Periodontol* 2000; 71: 1792-801.

### Unpublished article

[5] Garoushi S, Lassila LV, Tezvergil A, Vallittu PK. Static and fatigue compression test for particulate filler composite resin with fiber-reinforced composite substructure. *Dent Mater* 2006.

### Personal author(s)

[6] Hosmer D, Lemeshow S. Applied logistic regression, 2nd edn. New York: Wiley-Interscience; 2000.

### Chapter in book

[7] Nauntofte B, Tenovou J, Lagerlöf F. Secretion and composition of saliva. In: Fejerskov O,

Kidd EAM, editors. Dental caries: The disease and its clinical management. Oxford: Blackwell Munksgaard; 2003. p. 7-27.

### No author given

[8] World Health Organization. Oral health surveys - basic methods, 4th edn. Geneva: World Health Organization; 1997.

### Reference from electronic media

[9] National Statistics Online – Trends in suicide by method in England and Wales, 1979-2001. [www.statistics.gov.uk/downloads/theme\\_health/HSQ20.pdf](http://www.statistics.gov.uk/downloads/theme_health/HSQ20.pdf) (accessed Jan 24, 2005): 7-18. Only verified references against the original documents should be cited. Authors are responsible for the accuracy and completeness of their references and for correct text citation. The number of reference should be kept limited to 20 in case of major communications and 10 for short communications.

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