Anxiety prevention: implementing the 4 S principle in conservative dentistry

By Professor Laurence J. Walsh

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High levels of dental anxiety is a problem that many dental patients experience. Most recent studies in the international literature show that the prevalence of severe dental anxiety is approximately one in every 7 adults, and the same rate was documented in Australian adults in a 2006 telephone interview survey.[1] Most studies also show that females in the middle adult years have the highest prevalence, which also is true in Australia. Known effects of dental anxiety are many (Table 1) and impact upon the dental practice as well as upon the individual patient. Altered patterns of care are perhaps the most obvious impact of dental anxiety with disease having progressed to a stage too late for conservative measures to be effective. A surprising statistic from 2006 is that only 25% of visits in private general practice in Australia were for recall or maintenance - the same percentage as for treatment of dental caries as the presenting problem![2] This figure was not greatly different from the Brisbane Statistical District Survey of Adult Dental Health conducted in 1984,[3] in which the author participated as a field clinical examiner. Clearly, dental anxiety has not altered significantly over the quarter century period.

Severe dental anxiety is a multifaceted problem with no one common single causal factor in all patients (Table 2), although for most patients the stimuli for dental fear are sensory in nature. By focussing on these stimuli, the clinician aims to reduce the anxiety response at its sources, as opposed to dulling the response pharmacologically or by using distraction methods. The 4 S principle is based on removing four of the major sensory triggers for dental anxiety, and it is used in conjunction with other measures to mitigate anxious behaviours and their consequences.

Table 1. Consequences of severe dental anxiety

- Avoidance of dental treatment
- Cancellation of appointments
- Greater economic risk for the practice
- Poor compliance with follow-up treatment
- Negative expectations of treatment visits
- Longer time required for dental treatment
- Higher caries prevalence and severity (DMFT)
- Greater need for oral rehabilitation
- Poor oral health
- Reduced self confidence
- Feelings of shame and inferiority
- Negative thoughts
- Sleep disturbances
- Crying and aggression
- Lower satisfaction with treatment provided

Table 2. Causes of dental anxiety

- Fear of pain
- Fear of loss of control
- Conditioning experiences, such as past traumatic dental experiences in childhood Influence of dentally anxious family members or peers
- Sights, sounds and sensations of the dental drill
- Sights and sensations of dental local anaesthetic injections
- Angry and aggressive dental staff

The 4 S Principle is to reduce the 4 primary triggers of stress when in the dental setting, namely:

- Smells (e.g. eugenol and cut dentine);
- Sights (e.g. needles, air turbine drills);
- Sounds (drilling); and
- Sensations (high frequency vibrations - the annoyance factor).

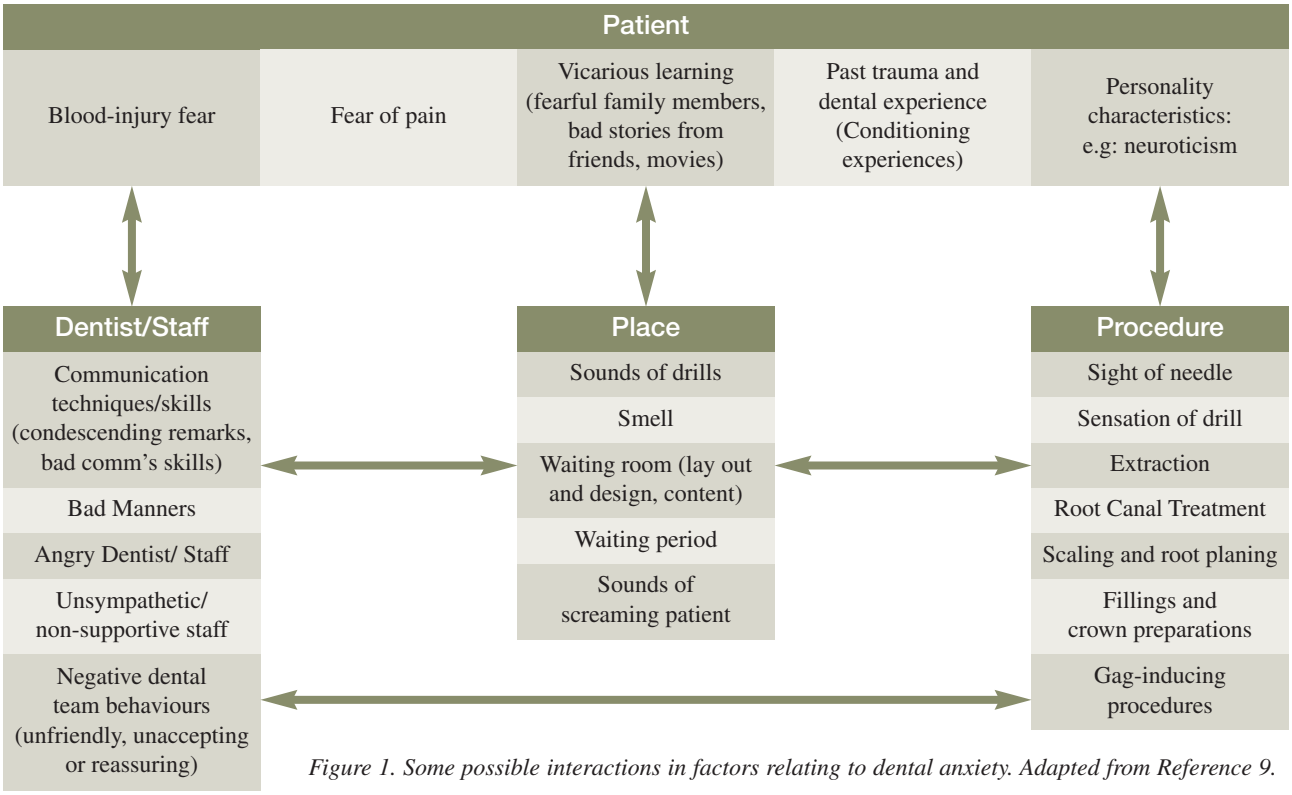

Figure 1. Some possible interactions in factors relating to dental anxiety. Adapted from Reference 9.

A range of approaches can be used for this, and they can be mixed and matched to meet the particular needs of the situation. Table 3 shows four commonly used alternative methods for dental restorative care (Ultra-low speed cutting, atraumatic restorative treatment (ART) with hand instruments, chemo-mechanical caries removal with Carisolv, and Erbium lasers), each of which reduces the smells, sights, sounds and sensations experienced during restorative dental care. This list is not meant to be exclusive, as there are other approaches that could equally be included, for example polymer bur cutting, air abrasion (alumina powder streams), particle streams in fluid media (e.g. Durr Vector ultrasonic with silicon carbide particles in a fluid medium), and ultrasonic tips coated with diamond particles.

To these methods should be coupled effective communication with patients, expressing sympathy and providing reassurance. The next higher level of intervention is training in relaxation and breathing techniques. In the most severe cases, these measures can be used after providing pharmacological support by conscious sedation techniques including oral, inhalation and intravenous sedation. Relaxation techniques are safe, have no side effects and give patients control over their anxiety levels. Like the 4 S methods, they work by eliminating or reducing the problem at its cause.

Ultra-low speed cutting leverages the reduced physical properties of infected carious dentine with its broken and degraded collagen crosslinks. A slow rotating instrument (e.g. 200 rpm with a #3 or #5 round bur) will remove this dentine but will not cut sound dentine to any great extent. This non-viable dentine has no viable odontoblast processes and can also be excavated by hand (as in the ART method), although care must be taken that the excavator is used with a whisking action so that excessive penetration pulpally does not occur. Patients who are not given LA and undergo ultralow speed cutting or ART provide interesting feedback on the experience. In a classic study in 1987, Ken Anusavice[4] (who in the same year authored the international guidelines on indications for placing and replacing restorations) in Florida conducted an intriguing clinical study in which some 47 patients who were not given an LA injection underwent restorative care. Some 34 of these (72%) did not request local anaesthesia for treatment, although nearly half (47%) experienced pain. Cutting or removing infected carious dentine, however, elicited little or no painful sensations, even though the patients could in some cases sense diffuse low frequency vibrations. The pain which was reported occurred once vital affected or sound dentine was cut. The nature of the pain (sharp, well localized, pin-prick) belies the fact that the tissue being cut is vital - and therefore amenable to healing. This begs the question, should dentine that can heal be cut away in the first place?

The same minimal intervention philosophy underlies the chemo-mechanical caries removal method. This targets collagen in infected dentine because of its broken crosslinks, which are susceptible to proteolysis by sodium hypochlorite and chloramines.[5,6]

Laser technology for caries removal in anxious dental patients has been in use for more than 20 years.[7] Avoidance of the underlying affected and healthy vital dentine is possible because of selective photo-mechanical and photo-acoustic effects that occur because of the volume expansion of rapidly heated water within the carious dentine.[8] Typically, patients undergoing cavity preparation with erbium lasers do not need local anaesthesia, a fact established from large scale clinical trials, in which only 2-5% of patients requested LA - even though many noted slight, intermittent sensations of cooling or vague shock-like sensations during laser pulses. There is a short-term analgesic effect created by the laser which attenuates these responses in most cases.

Using one of these four alternative methods of caries removal (or others), the clinician can apply the 4 S principle for restorative care in dentally anxious adult and child patients. As can be seen from

Table 3. Comparison of four approaches from the 4S perspective

Parameter	Ultra-low speed cutting	ART with hand instruments	Carisolv	Erbium lasers
Reduced need for injected LA	Yes	Yes	Yes	Yes
Dominant physical sensations	Low freq. vibration	Scraping	Scraping	Popping: shock waves
Likelihood of odontoblastic pain during caries removal	Moderate	Low	Very low to nil	Very low to nil
Basis of selectivity for infected carious dentine	Lack of collagen crosslinks (shear strength)	Lack of collagen crosslinks (shear strength)	Lack of collagen crosslinks (chemical reaction)	Increased water content (ablation threshold)
Suppressed nociceptor firing	No	No	Possibly, because of low pH	Yes (analgesic effect)
Annoyance factor during restorative treatment	Low	Low	Low	Very low
Smell and vapours	Dentine cutting	Nil	Hypochlorite and chloramines	Dentine ablation vapour if suction inadequate; typically nil
Cost of implementation in terms of equipment	Nil, as existing burs and low speed handpieces are used	Nil, as regular spoon excavators are used	Low. Gel is stored refrigerated and mixed when needed	Medium to high for initial purchase
Tactile sense	Yes	Yes	Yes	No, unless sapphire tips used
Accessing the carious dentine	Conservative access form	Conservative access form	Gel has no effect on sound tooth structure or restorations	Laser will remove resin and GIC, but not amalgam
Learning curve	Low	Low	Low	Medium
Ancillary guides for caries removal	Patient response	Patient response	Loss of opacity in the gel	Ablation sound, change change in fluorescence
Speed of dentine removal	Medium	Low	Low	Medium to high
Suitable for adhesive materials such as GIC	Yes	Yes	Yes	Yes
Antibacterial action	No	No	Yes (sodium hypochlorite)	Yes (photothermal ablation)

Table 3, these methods vary in their implementation but can all achieve a more pleasant patient experience. If we consider the high number of patients who currently avoid dental care, the impact of using these methods on those population subgroups can be very significant - as well as being professionally worthwhile.

References

1. JM Armfield, AJ Spencer, JF Stewart. Dental fear in Australia: who's afraid of the dentist? Australian Dental Journal 2006; 51(1): 78-85.
2. Brennan DS, Spencer AJ (ARCPOH). Practice profiles of Australian private general dental practitioners Australian Dental Journal 2006; 51(1):91-93, 2006.
3. Powell RN, McEniery TM. The Brisbane Statistical Division Survey of Adult Dental Health 1984. 2. Sociological aspects of the survey. ADJ 1988; 33(1):14-17.
4. Anusavice KJ, Kincheloe JE. Comparison of pain associated with mechanical and chemomechanical removal of caries. J. of Dental Research 1987; 66(11):1680-1683.
5. Ericson D, Zimmerman M, Raber H, Gotrick B, Bornstein R, Thorell J. Clinical evaluation of efficacy and safety of a new method for chemo-mechanical removal of caries. A multi- centre study. Caries Research 1999; 33:171-177.
6. Maragakis GM, Hahn P, Hellwig E. Chemomechanical caries removal: a comprehensive review of the literature. International Dental Journal 2001; 51:291-299.
7. Hibst R, Keller U. Experimental studies of the application of the Er:YAG laser on dental hard substances: I. Measurement of the ablation rate. Lasers in Surgery and Medicine 1989; 9:338-344.
8. Walsh LJ. The current status of laser applications in dentistry. Australian Dental Journal 2003; 48:146-155.
9. Hmud R, Walsh LJ. Dental anxiety: causes, complications and management approaches. International Dentistry, 2007. In press.

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