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. 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! This figure was not greatly different from the Brisbane Statistical District Survey of Adult Dental Health conducted in 1984, 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).
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 Anusavice¹ 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, 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

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

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

About the author
Professor Laurence J. Walsh is the technology editor of Australasian Dental Practice magazine. He has worked in clinical practice in special needs dentistry for the past 20 years and contributed to the development of preventive protocols for special needs patients.