INTRODUCTION

Before a patient can provide informed consent and agree to cooperate in treatment, it is crucial that he/she understand information relevant to the clinical procedures. This is especially important in invasive procedures, such as tooth extraction and/or implant insertion, in which results are usually non-reversible.

A person's cognitive ability to process information is significantly affected by stress (for review, see Kahneman, 1973; Hancock, 1986; Pilcher et al., 2002; Sauro et al., 2003). Nevertheless, in both the medical and dental fields, there is a constant need for information to be processed under stress. In one study, a considerable number of parents (about 20%) failed to fully comprehend the diagnosis or treatment directives given to them when their children were discharged from an emergency department (Waisman et al., 2003). In another, 40% of patients who had minor oral surgery did not remember receiving both written and verbal instructions, resulting in non-compliance with the post-operative instructions (e.g., 67% non-compliance with antibiotic prescriptions) (Blinder et al., 2000).

'Stress' is a general term whose meaning has changed considerably over the past decades. It is both a stimulus and a reaction, and includes both physiological and psychological components (Lazarus, 1969). One of the most stressful experiences in dental care is oral surgery (Wong and Lytle, 1991; Soh and Yu, 1992; Brand et al., 1995; Eli et al., 1997). For example, in periodontal surgery or implant insertion, there is a significant increase in patient anxiety immediately pre-operatively (Eli et al., 2000, 2003). Ritter et al. (2005) showed that dental procedures lead to stress, as measured by cortisol taken from saliva, and increased heart rate and (adjusted) blood pressure. However, in their study, the patients' performance on a set of cognitive tasks was not greatly affected when the patients were stressed.

In the present study, we used two oral surgical procedures, implant insertion and suture removal, to evaluate the effect of stress on the ability of patients to process information related to the implant surgery under a stressful clinical situation. The hypothesis was that patients' ability to recognize information would be lower in the high-stress condition (implant insertion) as compared with the low-stress condition (suture removal).

MATERIALS & METHODS

Participants

Initially, 88 patients were included in the study. All were healthy, with no history of systemic disease or regular use of medication. Patients were scheduled for implant insertion in a private clinic specializing in oral and maxillofacial surgery. The procedure was carried out by a senior oral and maxillofacial surgeon (DSA), under normal conditions (local anesthesia only, no pre-medication or sedation). Informed consent was obtained from all patients. The study was approved by the institutional human rights committee of Tel-Aviv University.
Evaluation of the pain expected during the anticipated procedure, on a 100-mm VAS ranging from 0 (no pain whatsoever) to 100 (worst pain imaginable), (Expected Pain – ExpP). VAS, a common tool to record the pain experience in both clinical and research situations, has been used previously to examine factors that affect the perception of acute pain in the dental situation (Eli et al., 1996, 1997, 2000, 2003).

(4) Patients’ evaluation of the extent to which they understood the information provided in the tape was measured on two 100-mm VASs: (i) a VAS that referred to the amount of certainty the patient believed he/she had regarding understanding of the supplied information, ranging from 0 ("not at all") to 100 ("completely"); and (ii) a VAS regarding the extent to which the patients believed that the supplied information was clear to them (ranging from 0 to 100 as above). A mean of the two VASs was calculated and labeled as Certainty of Understanding (CU) (Cronbach’s α = 0.98 and 0.99 in Times 1 and 2, respectively).

**Procedure**

The experiment was conducted in the waiting room, 10-30 min before the anticipated procedure. Patients were requested to listen to each informative tape on two different occasions: Time 1 (high-stress situation), immediately pre-operatively; and Time 2 (low-stress situation), 10 days later, before suture removal.

The study was a randomized cross-over design. That is, half of the patients initially listened (at Time 1) to Tape I, and secondarily (at Time 2) to Tape II; for the other half, the procedure was reversed (Tape II at Time 1 and Tape I at Time 2).

At each situation, the sequence was as follows (Fig.):

1. Completing the Dental Anxiety Scale (DAS); State anxiety on VAS (SA) and Expected Pain (ExpP)
2. Listening to the informative tape
3. Completing the VAS regarding Certainty of Understanding (CU)
4. Completing the recognition questionnaire and calculation (by the researchers on a later occasion) of the percentage of Correctly Classified Statements (CCS)

**RESULTS**

Although all patients did return for their suture removal appointment, 22 failed to listen to the tape and/or complete the questionnaires again. The reasons were usually lack of time or lack of patience on the part of the patient. A suture removal appointment is usually brief. Possibly, patients arriving for suture removal were psychologically prepared for a short encounter and showed less responsiveness to completing the research protocol once again. Therefore, only 66 (75%) patients completed both Time 1 and Time 2 questionnaires. There were 42 (64%) women and 24 (36%) men, with an average age of 51.7 ± 12.8 yrs. A series of t tests was performed that examined the differences between the experimental group (completed full protocol, N = 66) and those who dropped out after the first time (N = 22). The dependent measures were SA, DAS, ExpP, CU, and CCS at Time 1. No significant differences between groups were detected. Also, no age and/or gender differences were found between the groups, neither in comparisons between the experimental and the drop-out groups, nor in the comparisons between the cross-over design groups (participants who viewed the tapes in the 1-2 or 2-1 order).

A significant difference was found between the two measurement points for all variables, with anxiety (DAS, SA) and expected pain (ExpP) lower at Time 2 than at Time 1, and
certainty of information (CU) and score of correctly classified statements (CCS) higher at Time 2 than at Time 1 (Table 1). At Time 1, the CCS showed no "cannot remember" responses whatsoever. At Time 2, the percent of "cannot remember" responses on CCS was 7.6% [t (65) = 6.3, p < 0.01]. All comparisons, except for CU, remained significant after a Bonferroni correction for multiple tests was applied.

To understand further the factors that may explain the lower performance under the more threatening condition (at Time 1), we calculated a delta (Δ) score. Since the SA, ExpP, and DAS of all patients were lower at Time 2 than at Time 1, the Time 2 scores of these variables were subtracted from the higher scores at Time 1. For CU and CCS, the scores of all patients were higher at Time 2 than at Time 1. Therefore, for these variables, the lower scores of CU and CCS at Time 1 were subtracted from the higher scores at Time 2. Correlation coefficients of the Δ scores were computed for all variables. Only the Δ score of SA was significantly correlated with that of the other variables, including CU and CCS (Table 2). That is, higher anxiety in the high-stress condition, compared with that of the low-stress condition, was associated with lower information recognition (CCS) and lower certainty of understanding (CU) at Time 1 compared with Time 2.

To understand further the factors that contributed to the explanation of the Δ score of SA (and, through it, that may have an indirect influence on CCS), we performed a stepwise regression analysis in which the Δ scores of ExpP and DAS were used as independent variables. Both variables contributed significantly to the explanation of the Δ score of SA. The impact of the Δ score of ExpP (B = 0.64, ΔR² = 0.34, t = 6.06, p < .01) was three times higher than the impact of the Δ score of DAS (B = 4.31, ΔR² = 0.11, t = 3.29, p < 0.01).

**DISCUSSION**

Research with regard to stress and information in dental care is scarce. The existing research focuses mainly on the effect of pre-operative information on reducing anxiety and stress during surgery (Ng et al., 2004), and on increasing the patient's knowledge of operative procedures for the purpose of obtaining informed consent (Humphris et al., 1993).

The present study clearly showed that, in clinical conditions, the patient's ability to recognize and/or process supplied information may be severely impaired. Before a highly stressful procedure, e.g., dental surgery, patients recognized significantly less information than when faced with a less-threatening situation, e.g., suture removal. Furthermore, the general ability of patients to recognize information was quite low in both situations (CCS values of less than 50% at both times). The low percentage of CCS was more striking, in that the questions were posed to patients immediately after listening to the informative tape, and were presented in a recognition ("did the tape include information about...?") rather than a recall ("what was said in the tape about...?") format.

This result was interesting. If this finding is combined with the relatively high level of certainty that patients seemed to have about understanding the information (CU values of 69 and 72 at Times 1 and 2, respectively), it is apparent that patients' subjective report on this issue is unreliable.

This study confirmed previous findings that patients' state and dental anxiety are significantly higher before oral surgery compared with other dental treatments (in this instance, suture removal) (Wong and Lytle, 1991; Soh and Yu, 1992; Brand et al., 1995; Eli et al., 1997). Oral surgery can be considered a highly stressful situation, associated with a relatively high expectation of pain during the anticipated procedure. Unfortunately, many dentists are not sufficiently aware of the stress that dental procedures can cause, and its possible effect on their patients. For example, in situations involving periodontal surgery or implant insertion, a significant increase in patient anxiety can be found immediately before the procedure (Eli et al., 2000, 2003). It is not uncommon to supply patients with information regarding treatment immediately before (or sometimes even during) the actual procedure. This is sometimes practiced during procedures which may be regarded as simple, but may nevertheless impair the patient's ability to process the supplied information (e.g., explaining to the patient an unplanned change in a treatment plan due to unexpected pulp exposure during a restorative procedure). Even in patients who confirm that they properly comprehend the supplied information, this perception may be unreliable.

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<table>
<thead>
<tr>
<th>Variable*</th>
<th>Time 1 Mean (± SD)</th>
<th>Time 2 Mean (± SD)</th>
<th>t</th>
<th>p</th>
<th>Corrected p**</th>
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<tbody>
<tr>
<td>SA</td>
<td>39.8 (± 33.5)</td>
<td>12.2 (± 16.7)</td>
<td>7.3</td>
<td>0.000</td>
<td>0.000</td>
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<tr>
<td>ExpP</td>
<td>26.3 (± 27.7)</td>
<td>11.7 (± 17.6)</td>
<td>4.2</td>
<td>0.000</td>
<td>0.000</td>
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<tr>
<td>DAS</td>
<td>9.3 (± 3.3)</td>
<td>8.5 (± 3.1)</td>
<td>2.5</td>
<td>0.005</td>
<td>0.025</td>
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<tr>
<td>CU</td>
<td>69.2 (± 36.5)</td>
<td>72.2 (± 37.5)</td>
<td>2.4</td>
<td>0.015</td>
<td>0.075</td>
</tr>
<tr>
<td>CCS</td>
<td>38.9 (± 22.9)</td>
<td>47.2 (± 18.2)</td>
<td>3.4</td>
<td>0.000</td>
<td>0.002</td>
</tr>
</tbody>
</table>

* SA, state anxiety; ExpP, expectation of pain; DAS, dental anxiety; CU, certainty of information; CCS, correctly classified statements.

** Following Bonferroni correction.

<table>
<thead>
<tr>
<th>Study Variables as a Function of Measurement Points</th>
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<tr>
<td>Variable*</td>
</tr>
<tr>
<td>-----------</td>
</tr>
<tr>
<td>SA</td>
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<tr>
<td>ExpP</td>
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<tr>
<td>DAS</td>
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<td>CU</td>
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<table>
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<tr>
<th>Study Variables</th>
<th>Delta (Δ) Scores of the Variables</th>
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<tr>
<td>Variable*</td>
<td>DS-SA</td>
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<tr>
<td>DS-ExpP</td>
<td>0.58***</td>
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<tr>
<td>DS-DAS</td>
<td>0.31**</td>
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<tr>
<td>DS-CU</td>
<td>0.27**</td>
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<tr>
<td>DS-CCS</td>
<td>0.28**</td>
</tr>
</tbody>
</table>

* DS-SA, Δ score of state anxiety; DS-ExpP, Δ score of expectation of pain; DS-DAS, Δ score of dental anxiety; DS-CU, Δ score of certainty of information; DS-CCS, Δ score of correctly classified statements.

** p < 0.05.

*** p < 0.01.
It is noteworthy that, in the high-stress situation (Time 1), when the patients' level of CU was relatively low (69.2), the choice "cannot remember" was practically absent from their recognition questionnaires. With the increase in CU in the low-stress situation (score of 72.2 on Time 2), the percentage of "cannot remember" responses increased significantly (from 0% to 7.6%). This finding is intriguing and calls for further research.

It has been suggested that anxiety experienced during dental treatment plays a role in maintaining the problem of the patient's inaccurate expectations of fear of treatment (Arntz et al., 1990). In our study, changes in state anxiety (SA) can be explained by changes in the patient's expectation of pain (ExpP) and dental anxiety (DAS). Although the above model assumes that DAS 'caused' SA, the opposite is also possible. The increase in state anxiety (Δ score of SA) was significantly associated with a decrease in certainty of understanding and a decrease in the percentage of correctly classified statements (Δ scores of CU and CCS). Thus, it appears that state of anxiety, dental anxiety, and expectation to experience pain have a profound effect on the patient's ability to recognize correctly the potentially important information provided before treatment.

Undoubtedly, dental treatment is a stressful condition, and when a person is under stress, cognition may be influenced in specific ways which have not been defined (Ritter et al., 2005). It is important that further research be conducted to specify how the clinical dental situation may affect the ability of our patients to understand, remember, and apply information supplied to them before, during, and after treatment.

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REFERENCES


