WASH YOUR HANDS OF TRADITION . . . IT'S TIME TO TURN ON THE T.A.P.

C Forster, Speech and Language Therapist, MBPCT;
P Mallett, Senior Chief Maxillofacial Technologist,
Royal Lancaster Infirmary

Tactile feedback has been successfully implemented in many different areas to improve performance of techniques. Akamatsu and MacKenzie[1] demonstrated that tactile feedback has been shown to enhance speed and targeting abilities in computer skills. Their study showed that you could reduce errors made when using a mouse by adding tactile feedback. The results of the study indicated that modifying a mouse to include tactile feedback offers performance advantages in target selection tasks. Nurse and Nigg[2] hypothesised that sensory feedback from receptors in the feet may play a role in regulating gait patterns. Their study indicated that the body can detect and respond to external stimuli, suggesting that neurological feedback should be incorporated into any model that attempts to explain gait patterns.

When considering early development of children a recognised stage of development is that of "mouthing", where the child uses tactile stimulus (putting objects in their mouth) to explore and examine objects in their new world. Bee[3] acknowledges that children of 12 months or so spend time exploring and manipulating objects using all the sensorimotor schemes in their repertoire. They will put things in their mouth, stack them, shake them and move them along the floor. In this way children come to understand what objects can do. When tactile stimulation has been proved to be such a strong learning tool it might be supposed that it is naturally implemented into therapy, particularly speech and language therapy.

An attempt has been made to introduce tactile stimulus with adult clients, in the form of shaped rods that are held in the mouth to provide feedback for tongue movement, but these have had little impact with the paediatric population as they have proved to be cumbersome and distracting. Generally however, tactile feedback appears to have been largely overlooked in the field of speech and language therapy.

A new technique has been developed resulting from the following case study.

CASE STUDY

Alex was a young boy aged eight years and eleven months who presented with disordered phonology (speech sounds). Alex found segmenting words and blending sounds very difficult. He persistently substituted sounds in his phonology, which could make him unintelligible. Alex had received eleven blocks of therapy (group and individual – a block equals one half hourly session a week, over six weeks) all following a traditional therapy approach. Traditional therapy targeted auditory discrimination (listening for the differences between sounds), segmentation and sound blending, systematic babble (repeating sounds in patterns) and metalinguistic approaches to phonology. Metalinguistics is establishing a language about sounds, for example, "long sounds" can be held for a long time, such as /s/, /z/, /f/, and /v/, "short sounds" can not, /p/, /b/, /t/, /d/, /k/, and /g/. "Front sounds" are made at the front of the mouth, /t/ and /d/, "back sounds" are produced at the back of the mouth, /k/ and /g/, and so on.

Alex had been involved with a centre of excellence but over a period of two years, progress had been minimal and Alex could be unintelligible out of context. The following chart gives an overview of Alex's main substitutions and limited progress over two years.

	November 1997		June 2000	
Target Sound	Word Initial	Word Final	Word Initial	Word Final
t d	t,st,ch g	glottal stop d	t g	glottal stop d
k g	t,ch g	glottal stop d	t,ch g	glottal stop d

From the chart it can be seen that Alex has two main difficulties:

- words beginning with /d/ (as he substitutes a /g/, for example, ***dinner*** becomes ***ginner***)
- words ending in /g/ (as he substitutes /d/, for example, ***log*** becomes ***lod***).

The glottal stops are regionally acceptable in this geographical area.

Alex's motivation was almost zero. He had tried every therapy available to us and was quite frankly "fed up".

INNOVATION

A palate was designed which used colour and immediate tactile feedback to help Alex feel where he was supposed to place his tongue for certain sounds.

Two main articulatory areas were targeted; alveolar (just behind the front teeth) and velar (at the back of the mouth). These areas are where Alex would have to make his target sounds, alveolar plosives /t/ and /d/, and velar plosives /k/ and /g/. The palates were colour coded to highlight the target area when the palate was held in the hand, making it visually

obvious where the target area was. Alex had an impression taken at the dentist and then the palates were made.

HOW THE PALATE IS MADE

There are currently three design variants in use. Here is a brief description of two of the designs used: -

APPLIANCE 1 – ALVEOLAR TACTILE ACRYLIC PALATE

A plaster model of the patient's teeth and palate is fabricated, then an area directly behind the maxillary central incisors and below the plateau of the cingulum should be identified and marked on the plaster model using a suitable marker pen or pencil. This area should have a posterior border at 10mm from the most mesial point of the incisal papillae and be no wider than the palatal surfaces of the central incisors.

The teeth should be assessed for the provision of suitable clasping to ensure the appliance does not become loose or dislodge during normal use. The type of fixation component will vary depending upon the nature of the patients' teeth as they are presented. The clasps are formed and placed on the model with wax to hold them in place.

The cold cure acrylic base plate is built up in the usual way. To increase the patient's motivation and resultant compliance, the base plate is made using an acrylic resin in a colour or with a glitter additive of the patient's choosing. Additionally, as a permanent guide to the letters/sounds to be practised when using the appliance, for the patient or patient's parents, letters can be embedded in the base plate for example, in this instance /t/ and /d/.

Following the build up of the base plate, the area behind the central incisors, as identified previously, is trimmed away and cold cure acrylic of a different colour to the base plate is built up in the void. The base plate is finished and polished in the usual way. The tactile area behind the central incisors is now textured, by making hemispherical pits using a round bur. The appliance is then ready for use.

APPLIANCE 2 – VELAR TACTILE ACRYLIC PALATE

This appliance is formed in the same way as for appliance 1 but with some modification. Instead of having depressions behind the maxillary incisors, an area proximal to the border of the hard/soft palate is identified, then during the build-up of the base plate, this area is over-built into a small mound or tore using a cold cure acrylic of a different colour to that used for the rest of the base plate.

Letters are again placed in to the base plate. In this case we inserted the letters /k/ and /g/. Following processing, the appliance is trimmed and polished in the usual way without reducing the mound in the palate. The mound is now textured by cutting square pyramidal shapes in it, and lightly polished as before.

TAP – TACTILE ACRYLIC PALATE

The first palate was made to target /t/ and /d/, which are known as alveolar plosives and made with the tip of the tongue just behind the top front teeth. This has been

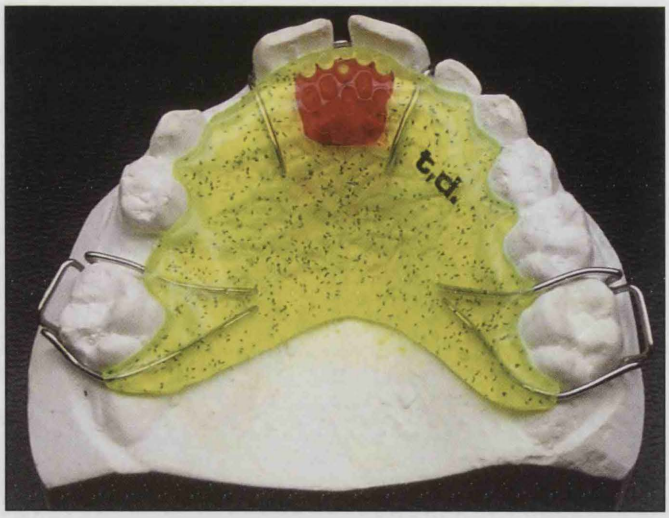

Figure 1 Alveolar TAP.

temporarily named the alveolar TAP (Tactile Acrylic Palate) and is shown in Figure 1. The palate is upside down as it would normally sit up against the roof of the mouth.

The second palate was made to target velar plosives, /k/ and /g/ and is temporarily known as the Velar TAP. This can be seen in Figure 2.

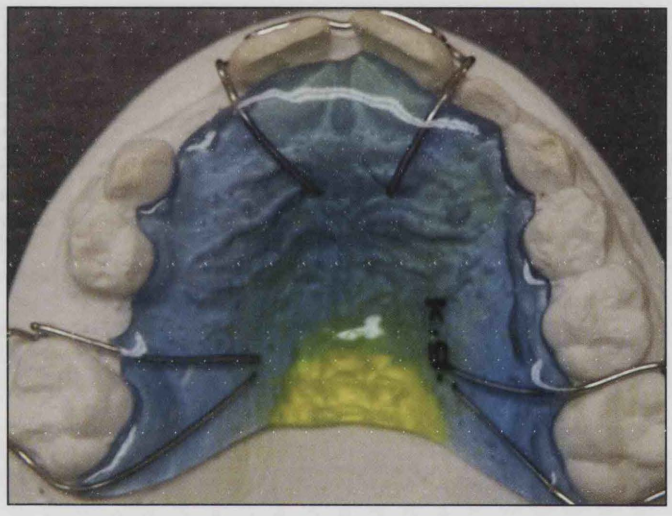

Figure 2 Velar TAP

The palates were stamped with the target sounds to enable independent practice by Alex, as he no longer relied on parents/guardians to tell him which palate to use to practise which sounds.

A patent application has been submitted for this invention.

THERAPY

The palates were given to Alex with hygiene sheets to enable him to care for them appropriately. Therapy began and some basic rules were followed:

- Practice with the palate would last for no more than ten minutes up to three times a day. It was felt that if worn for any longer Alex could become desensitised to it and it would be redundant.
- Alex described the target areas once he had felt them with his tongue. He used the term "bumpy", therefore this term was constantly used as a mutual dialogue was developed between the therapist and Alex.

- instead of attempting to say the sounds directly, time was spent feeling for the target area and placing his tongue in the starting position.
- time was taken to feel for the bumpy area and moving the tongue away (usually down) from this area. It was felt that if therapy targeted a specific sound (for which Alex had already received a lot of therapy) Alex's motor planning and automatic muscle movement would continue to repeat old and incorrect patterns. Therefore therapy only targeted movement initially and not making a specific sound.

Once Alex could make the appropriate muscle movement he attempted the sound successfully and this was then repeated to enable it to become a new habit. Once at this stage, traditional metalinguistic therapy was repeated with the additional use of the palate.

RESULTS

Alex received a week of daily half-hour sessions followed by one half-hour session a week for six weeks. His progress was almost immediate. During Alex's second session he began to self-monitor his speech. This meant that as Alex made a mistake he could recognise this and would repeat the sound/word correctly without any prompting from the therapist.

Alex was recorded naming fifty pictures before and after the use of the palate. The pictures included a range of alveolar and velar plosives in all word positions (beginnings, middle and ends). The list also included some consonant clusters, such as /st/ and /sk/ (as in *stick* and *skate*). He was required to label fifty pictures nine times before the palate was introduced and then repeat this process after treatment. This enabled a comparison of his speech sounds before and after treatment.

The graph below displays the percentage of change in Alex's production of alveolar and velar plosives.

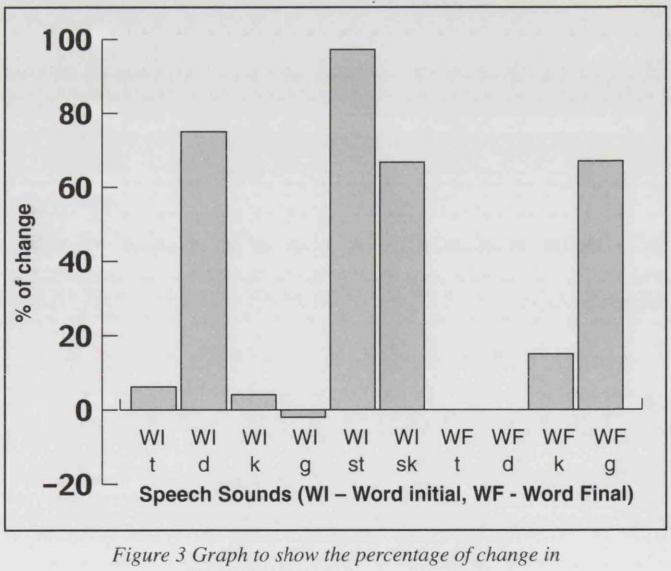

Figure 3 Graph to show the percentage of change in Alex's speech sounds after treatment

It can be seen that Alex made significant progress in the two target areas, word initial /d/ and word final /g/. He improved word initial /d/ by 75% and word final /g/ by 67%.

Alex made no change in word final /t/ and /d/ as these sounds were correctly articulated before treatment. He did make a small positive change in word initial /t/ (6.2%), word initial /k/ (4.1%) and word final /k/ (15%). This small change can be explained because Alex was inconsistent before the treatment, sometimes articulating the sounds correctly.

An interesting aspect of the results is the change in word initial /g/. This suffered a negative change of -2%. Perhaps this could be explained as Alex's difficulties spun from interchanging /t/ and /d/ with /k/ and /g/. He appeared to continue this pattern with word initial /g/. Alex's "new habit" of producing correct sounds still required a lot of thought and concentration from Alex and when concentrating on word initial /d/ he may have over generalised this skill leading to the deficit of word initial /g/. It could have been expected that this would be self-corrected by Alex with a little time. (It can be reported that this was the case with Alex and he no longer has this problem.)

Although consonant clusters, such as /st/ and /sk/, were not targeted in therapy Alex made a dramatic improvement with both these clusters. He improved /st/ by 97.2% and /sk/ by 66.7%. This is presumed to be a generalisation of his new learnt sounds.

Alex's motivation whist using the palates appeared to be renewed as he could practise independently with the palates and use the labels on them to avoid confusion. His experience of success with these sounds appeared to boost his motivation to practise further and very quickly he integrated the sounds into his spontaneous speech. All these changes have been maintained by Alex with no regression to date.

CONCLUSION

The use of immediate tactile feedback provided by the Tactile Acrylic Palate enabled Alex to find the correct tongue position for his difficult sounds. By repeating these sounds, with the use of the palate, he was able to replace an old habit of incorrect sounds with a new habit of correct articulation. We can surmise that, using the palate, Alex was able to perform the necessary repetition of the new habit to reprogramme his motor planning from the brain to the muscles in his articulators, in order to maintain the new habit of producing the correct sounds.

The use of colour on the palate appears to have helped Alex to visually map his own mouth. By remembering which coloured parts were where and knowing that the tactile area was a certain colour Alex was able to 'map' his own hard palate giving him the additional cue of visualisation of how and where to make the sounds.

FURTHER RESEARCH

This method is currently being further tested on a pilot study group. The results are not yet complete but to date are favourable. It may have implications for other client groups within speech and language therapy. It could help a dyspraxic client to find the starting point to make specific sounds. From here the necessary repetition can be practised to allow the automatic muscle movement needed to coordinate several speech sounds together. The repetitions cannot be practised if the client is unable to find the correct starting position.

If this hypothesis is true, research could be carried out to investigate the use of this technique with acquired dyspraxia (re-establishing motor patterns) and developmental dyspraxia (where motor planning and patterns have yet to be

established). It is also possible that stroke clients or head injury clients could benefit.

In today's NHS where evidence-based practice is central to our clinical work, a larger study needs to be conducted to establish more extensively the results of a technique which current evidence indicates can and does work. This is being pursued.

Acknowledgements
With thanks to Mr Gordon McCracken, Consultant Orthodontist (retired) and Ms Janet Smith, Community Dentist, who kindly took the impressions for this study.

REFERENCES

1 Akamatsu M, MacKenzie S. Movement characters using a mouse with tactile and force feedback. Int J Human-Computer Studies, 1996; 45: 483-493

2 Nurse MA, Nigg BM. Quantifying a relationship between tactile and vibration sensitivty of the human foot with plantar pressure distributions during gait. Clin. Biomechanics 1999:14(9); 667-672

3 Bee H. The Developing Child, 6th ed. New York. HarperCollins College Publishers 1992

FURTHER INFORMATION

For further information please contact:
Claire Forster, Speech and Language Therapist,
clairef007@hotmail.com
Paul A Mallett, Senior Chief Maxillofacial Technologist,
Paul.A.Mallett@btinternet.com