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EDITOR'S NEWSLETTER

Dear Colleague,

MORE ON ANOMALIES AND RESEARCH

It seems that if one considers anomalies in relation to research, one opens Pandora's Box on an area which is an emerging interest in many disciplines. That is, many professionals are breaking away, not only to explore new methods of analysis as discussed in the next section, but also to explore new fields of study. To put the matter quite bluntly, *research is becoming more exciting and relevant to clinical reality.*

Hypermobility of joints

Studies have already commenced to see if there is a relationship between the hypermobility of various joints in the body and the susceptibility to temporomandibular joint dysfunctions. One index of hypermobility involves checking specific joints in the body to rank the hypermobility of the individual's joints. For example, most readers will be aware of a person who can touch their arm with their thumb. This is one of the indicators of hypermobility.

One could speculate that the significance of this to orthodontic treatment is that patients with joint hypermobility may be those who require a full functional occlusion at the end of treatment. Dr Ronald Roth, in a recent course on Functional Occlusion in Melbourne, suggested that certain people tolerate improper occlusal functions at the end of orthodontic treatment, but problems may surface some years later. It could be that it is these people with hypermobility of the joints who may have a susceptibility for TMJ problems later, and so they may be the ones who require correct and detailed finishing at the conclusion of orthodontic treatment. Some indication for serious research into the matter could be gleaned by recalling post-orthodontic TMJ cases to test for hypermobility. If this is found to be so, the tests for hypermobility are non-invasive and thus could be done by staff as part of the original orthodontic assessment.

Triad therapy in orthodontics

Triad therapy has been mentioned previously in these Editor's Newsletters. In personal discussions with Dr Charles Slack, who has written extensively on this therapy, it has become obvious that there is an area in orthodontics where Triad therapy is applicable. This is in the situation where a second member of a family is receiving orthodontic treatment. If the younger sibling attempts to gain sympathy or attention by exaggerating the difficulty of wearing the orthodontic appliance the elder sibling may act as the 'Ex' (patient). That is, the elder sibling may make some comment such as "Mum, do not pay any attention to him about that."

It could be that this Triad situation may explain partly why treatment of younger siblings in a family seems to take 3-4 months less treatment time than other children. Well planned qualitative research, which can concentrate on a microcosm such as the family, (Mollenhauer 1984) may also elicit that the parents, having gained confidence from the orthodontic treatment of an elder child, pass on this confidence to the younger sibling. The effects on cooperation and treatment time can be even more dramatic when one of the parents is an 'Ex' (patient) of the orthodontist. This is indicated by the parent saying 'She is going to wear her elastics better than I did'.

An important principle of Triad Therapy is the need for daily group sessions. Occasionally a patient is seen with a pitiful standard of oral hygiene. Daily visits to the orthodontic practice can have traumatic effects, but the cost in petrol for such daily visits may be a major factor in such regimes.

The value of a *pilot qualitative study prior to formal quantitative research should not be underestimated* because a number of factors can be elicited which may not have been otherwise taken into account in the formal research design. Unfortunately, many qualitative studies are not presented in the formal literature due to the fact that they are swallowed up by the main study; or the research is abandoned altogether because the person needs to earn an income. Less commonly, a methodology could not be found to take all the variables into account for the proposed quantitative research. This last problem may be solved with EDA displays (see later). Thus, the Butterfield Committee (BDJ Leader, 1986) should have little difficulty in finding suitable research projects.

Anchorage variation

In treating large numbers of families, another phenomenon also becomes obvious. This is the matter of anchorage control. Occasionally one treats a family where intra-oral anchorage is very difficult to control. The phenomenon can also be seen in cousins of these siblings. If similar appliances are used for these children as for other patients, the thought occurs that these families have different osseous architecture in the alveoli regions. One wonders if biochemical or radioisotope assays may shed some light on these patients. As with all treatment, it is preferable to know beforehand the problems one may encounter and so be forewarned.

With the help of the Muses, management of the variations which are seen clinically, and which make orthodontic practice so interesting, may be expressed thus:

ORTHODONTICA PRAGMATICA
Due to the complexitie
And diversitie
Biologic,
We cannot agree
T'with the K.I.S.S. principle
In treatment
Orthodontic;
Where K.I.S.S. stands for Keep It Simple,
Stupid.

Intrusion by cicatrization

Seventeen years ago this author followed on the work of Ewen and Pasternak (1964) to enhance the stability of space closure where lateral incisors were congenitally missing.The intention was to do research for a further degree which was not fulfilled. Nevertheless, some interesting observations were made in relation to the reverse-bevel gingivectomy. Firstly, the retention period required was more in the realm of six months than six weeks. Secondly, the effects lasted for three to four years, but thereafter, the occlusion took over. Such procedures could be an alternative research instrumentation for collagen metabolism. Thirdly, the cicatrization of the scar tissue not only held the teeth together, but it produced an intrusive action which needed to be compensated for in cases with initial minimal overbite.

'FINGERPRINT' E.D.A. DISPLAY

As well as established confirmatory analysis methods, new methods such as Exploratory Data Analysis are being added to the armamentarium for studying data. These methods appear to be particularly applicable to clinical data. By presenting or displaying the data in specific forms, it is possible to highlight certain features. One example of this is the Boxplot display ***Figure 1*** that can

be generated by the statistical computer package Minitab*. The advantage of the Boxplot display is that it displays exceptional cases away from the median. A further enhancement is the 'Notched Boxplot' *Figure 2* that further allows one to display the level of confidence at the 5% level.

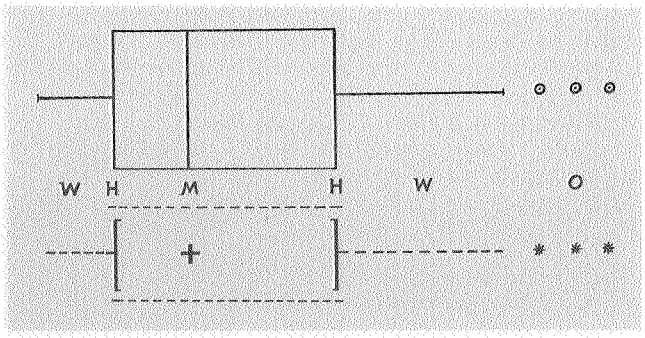

Figure 1. Basic boxplots - hand drawn type above, and computer generated type below. They show at a glance the median (M) and the spread, which is shown by the hinges (H), whiskers (W) and outliers (O). For further information on boxplots, see Velleman and Hoaglin (1981) pp 65.

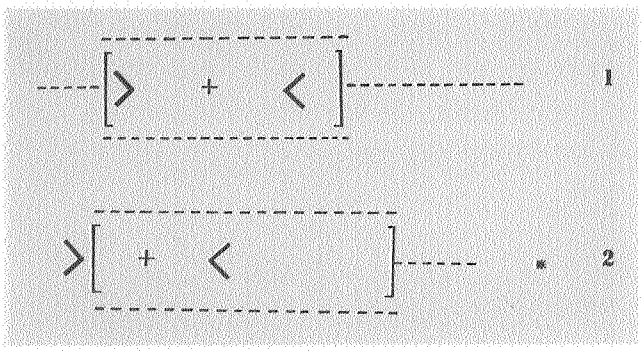

Figure 2. Multiple notched boxplots not only display groups of data, but also warn against concluding that the groups are significantly different at specified confidence levels, which are indicated by the notches. In this illustration, the notches are shown as greater than, and less than, signs. Some computer printouts use round brackets for the notches. Despite the differences in the medians (+) in this example, there is some overlap between the notches, indicating that group 1 and group 2 may not be significantly different.

Velleman and Hoaglin (1981) discuss the Notched Boxplot display as well as explaining its implementation using Minitab.

Prior to this, they explain the Stem-and-Leaf method of data presentation, previously described briefly in this publication (McLean 1986). An example is also seen in *Figure 3.* This particular display has two important advantages. Firstly, it allows an author to present the raw data in a compact form such that other people may reuse this raw data. Secondly, those results away from the median can be inspected for special features. If such a group of results is seen away from the main body, one is able to trace back to those individuals in the sample to assess the reason for the exceptional group. For example, assume that a clinician was investigating the response of patients to various appliances, one of which included intermaxillary (Class II) elastics. In the batch of data values, it was noted that some individuals exhibited extreme backward mandibular rotation. When this group was examined in detail, it may have been shown to be a group of dolichofacial types treated during the growth spurt. This example shows that separation of an isolated group could show a contra-indication for treatment at certain times. Naturally, a larger batch of these individuals would need to be collected to compare them with the other group to formally establish a significant difference. The point is that Exploratory Data Analysis techniques provide a means of differentiating between groups.

A stem and leaf display is an approach to grouping which does not discard information of values to the extent that ordinary grouping does. It groups on the basis of the decimal number system, and creates something which is part table and part graph. Using it, the set of values

27.31 28.56 28.64 28.68 29.28 29.53 30.64 32.50

may be represented as:

27	3
28	566
29	25
30	6
31	
32	5

The 'stem' consists of the leading digits, the 'leaves' consist of the first trailing digits. The choice of the split between leading and trailing digits is up to the analyst. This approach can be extremely useful in the initial stages of data analysis.

Figure 3. "Stem and leaf" display. Reproduced from McLean (1986) - Australian Orthodontic Journal 9 (3): 284.

There is a large number of exploratory techniques. Velleman and Hoaglin (1981) select nine for presentation. Their book is highly recommended for both clinicians and researchers. Following the theme presented in the last Editor's Newsletter, namely, that various disciplines require their own customised mathematics, the following display is suggested for the analysis of the response to orthodontic treatment. The *specifications for this 'fingerprint' display* are threefold:

1. That the batch of data values be presented graphically for visual comprehension.
2. That the raw data be presented in compact form so that
(a) it does not consume large amounts of space in journals or textbooks, and
(b) other workers can use the raw material to incorporate it with their own results or to re-analyse it using other mathematical techniques.
3. That comparisons can be made with other batches of data.

Cephalometric composites satisfy the first and last specifications. However, only the means of the values are extracted to construct the cephalometric composite so that deviant or outlying values are lost.

There are four steps in the proposed display:
1. The data on *each variable of each patient* is documented (or it is converted into standard deviations).
2. The data groups are placed in boxes or spreadsheet cells.
3. This original display is reduced in size by an appropriate amount, usually to one fifth of the original size, so that *the raw data can be read with a magnifying glass* if required.
4. Overhead projector slides are made of each batch of data values to enable comparison with other batches of data values, in a manner similar to that used for comparing fingerprints.

The advantage of using a standard-deviation presentation is that patterns can more easily be seen within the boxes or cells.

The example given in *Figures 4 and 5* is the movement of Pogonion as a response to treatment and growth of a group of individuals. The usually accepted indicators of mandibular response are included in the raw data as well as data on the patient's age at commencement of treatment, radiological stage (Gruelich and Pyle), sex, number of relations treated, year of commencing treatment, and even the patient's number. The reason for most of this information is obvious, but the patient's number would confirm that correct random sampling techniques were employed for the control sample. In this illustration, each square would indicate 1mm of movement of Pogonion in various directions

relative to a conventional registration reference such middle cranial base (in this example) or CC point.

By means of this type of display, authors could not only display and compare groups as can be done by cephalometric composites, but also other authors or clinicians could regroup the individuals or data to test other hypotheses, which may not have been considered by the authors of the article.

Matrix algebra would complement such displays. One might even go so far as to speculate that Hilbert curves (Ackerman, 1986) and the Mandelbrot Set (Grouse, 1986a) could be considered as a complement. Only those interested in Fractal Geometry would be interested in following up this line of thought.

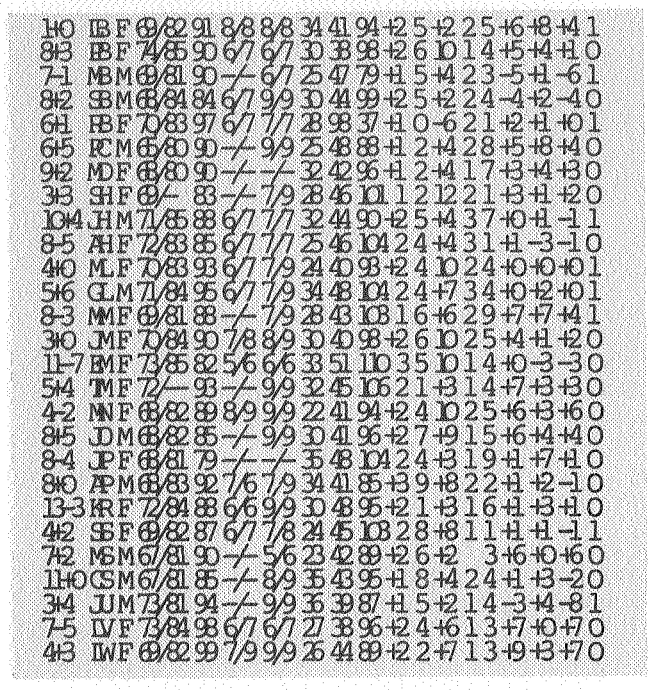

Figure 4 (a). EDA "Block fingerprint" of raw data in alphabetical order of patients' initials, typed at 20 cpi. The first two digits indicate the response of pogonion to treatment (see Table 1). A dash (-) indicates that data is not available. Note the missing data in the fourth bottom line containing patient M.S.'s features, and how it shows up in subsequent reductions.

Figure 4 (b). Reduction of "block fingerprint" display to 50%.

Figure 4 (c). Reduction of "block fingerprint" display to 20%. To read, use a magnifying glass. For comparing "fingerprint" displays see text re use of overhead projectors.

TOWARDS PARADIGMLESS ORTHODONTICS

Firstly we must state what such an objective entails and then consider how it may be achieved with several detailed examples.

General comments

'Scientific paradigms are not only constellations of beliefs, values, and techniques shared by members of a given community but also concrete models that can serve as a base for solving remaining problems' (Kuhn, 1970, cited by Carlson). Carlson (1985) states that 'paradigms provide a coherent conceptual scheme for organising observations and ideas, ***determining which observations are relevant, determining which problems are legitimate,*** and indicating how these problems probably should be solved.' Carlson goes on to give examples of two opposing paradigms - evolutionary biology and creationist biology.

Table 1. - Details of sample of cases exhibiting maxillary rotation used in 'fingerprint' EDA display. (Figures 4, 5(b), 5(c)).

General Variables and comments. The sample was taken from:

Solo practice, established 1968;
located in middle socioeconomic area;
period of sample is 1980 to 1986;
Begg technique;
second tracing was from routine prefinishing ceph. taken near the end of IIIrd stage, often when the bite is still 'jacked open' i.e. before cuspal interferences are reduced by the finishing archwires;
geographic horizontal (Seward 1968) was used instead of anatomical Fh;
many of the specific variables listed below are considered to be indicators of growth direction;
the sample was not a random sample, but rather all maxillary 'rotators' found because of the low incidence. Unfortunately, *this sample is too small to exploit the full potential of the 'fingerplate' display*;
mandibular rotation were related to middle cranial base which partially explains the excessive backward rotation found in these patients;
the display could be compared with a random sample of other cases, post-treatment observations of the same cases, a non-treated sample, etc.; but, more importantly, *by collecting more of the same type of case, various groupings or 'blocks' of response may be elicited.*

Specific Variables - in order from the left of the display

Initials of patient
1. Sex
2. Year of birth/start treatment
3. Facial Axis
(Development Stages)
4. Medial/distal phalangeal - time of first records
5. Medial/distal phalangeal - time of second records
6. Mandibular arc
7. Lower face height (degrees) Pm Xi - Xi Na
8. Cranio-cervical angle: CVT - Geog. Horizontal
9. Antegonial notching in ranking of 1, 2, 3
10. Overbite in mm
11. Taylor's A-B difference
12. Condyle size - in ranking of 1, 2, 3
13. ANS - Subnasale horizontal : pretreatment (vertical) - mm
14. PNS - Subnasale horizontal : pretreatment (vertical) - mm
15. ANS - Subnasale horizontal : in-treatment (vertical) - mm
16. PNS - Subnasale horizontal : in-treatment (vertical) - mm
17. Siblings also treated in practice

Omitted but possibly relevant variables

Nasopharyngeal patency;
Constitutional type;
Soft tissue analyses including Worm's.
Occlusal plane features.
Microrhinodysplasia
Cooperation

One could argue for and against the use of paradigms in orthodontics, which has had its ample share. There may be a case for paradigms as a temporary practical teaching approach. For example, in the early years of a dental course, it is quite proper to teach the Angle classification of Class I, Class II, and Class III. As the student proceeds towards the end of the dental course, and particularly for the post-graduate orthodontic student and the orthodontic practitioner, this classification becomes over-simplistic for practical purposes in treatment planning. For example, very few experienced orthodontists would not take into account the difference between dolichofacial and brachyfacial Class II

malocclusions. Even if two consecutive cases of each type were treated with the same extractions, for example, the reasons could be quite different for the two types. It is necessary to consider all the variables and weigh them all up, for every case, rather than set a 'cookbook' or 'probabilistic' course of treatment. In general, the differentiation between the two types of faces will heavily influence the extraction pattern. But it is not only the early dental student who would see things in a simplistic light, it also occurs with para-dental personel. The more one learns, the more murky the borders of classification become. The amusing quotation 'Isn't it a pity that all life's problems don't come to us at sixteen years of age, when we know all the answers!' emphasises this premise. The point is that categorical statements as found in paradigms are easy to quote, to argue from, and to intellectually escape back to. Probably intellectual maturation can be seen as a series of steps. That is, one may go upwards into new areas of concepts or procedures but at some stage the system needs to be stabilised and integrated with other facets of professional and personal life. For example, one needs to deal with the rigours of those parts of the day in every practice where there is a heavy workload. It may not be possible to analyse the old paradigms and redefine new paradigms in these rush periods. If one was to consider the flat parts of the stairs as a time for consolidating paradigms, the question arises how often does one undertake another vertical step. Not only can this happen on a daily basis at some stages, but often one has several projects on at the one time which may or may not be related. This is a completely different time frame from that expressed by Moss (1983) that a scientific generation lasts five years.

Personally, and as a profession, we must *be on guard against an over-reaction to previous paradigms.* Usually it is not the person who creates the new paradigm who is the problem; but rather it is the extreme swing in the other direction related to the circumstances in which the new paradigm is presented. To use an analogy from golf to explain this: Assume a golf instructor is trying to curb a natural slice in his pupil. The instructor may emphasise a technique which is, in effect, a hook to get that particular pupil to a more neutral fade. If the same instructions were given to a second person with a neutral drive, the result would be the development of a hook. To extend the analogy: how forcefully the golfing instruction is given would be determined by how long the first pupil had had the slice. If that person had been playing for many years, he would require a different level of 'insistence' than somebody who was just beginning. In Australia, the phenomenon of over-insistence probably occurred in regard to non-extraction therapy. Our forefathers in this country reacted to the extreme non-

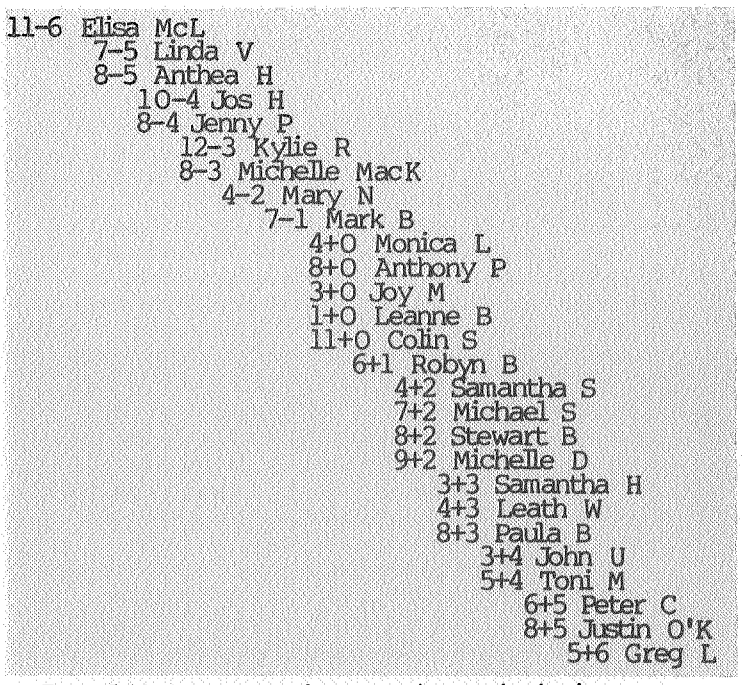

Figure 5 (a). Arrangement of patients in horizontal order, for placement in (spreadsheet-like) cells, as in Figures 5 (b) and 5 (c).

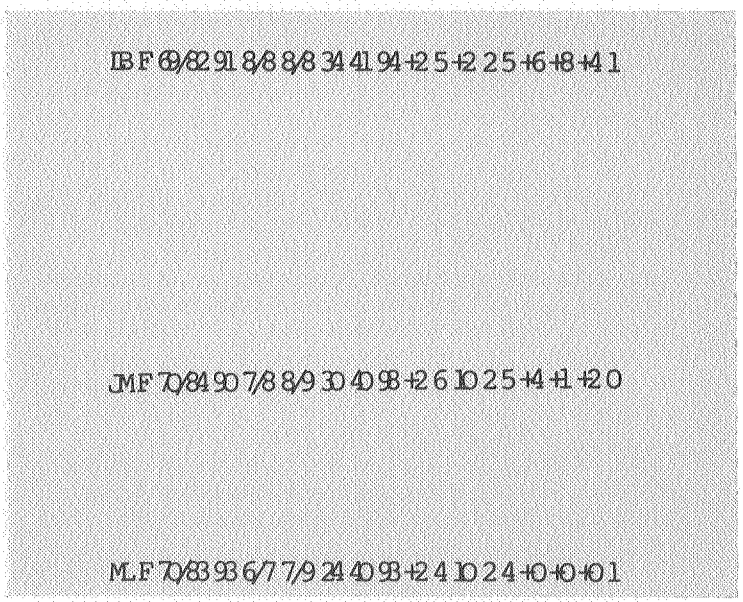

Figure 5 (b). Part of "Cell fingerprint" (see below in column O) showing the contents of cells in standard-size Courier typing at 20 cpi.

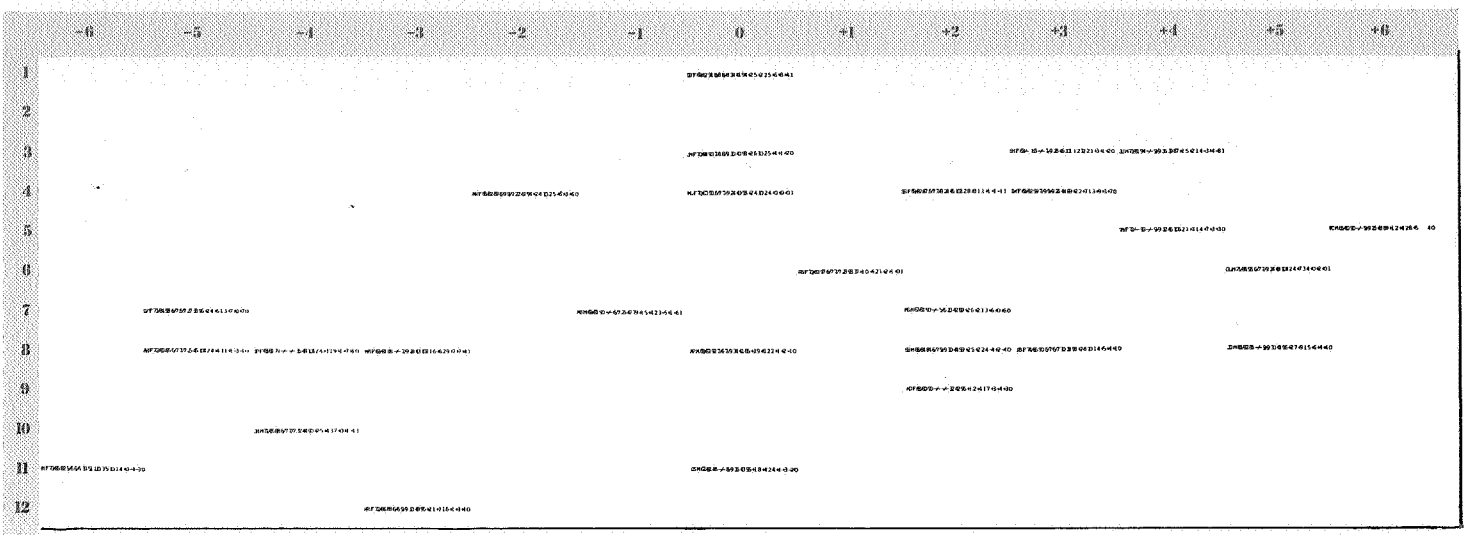

Figure 5 (c). Complete "Cell fingerprint" EDA display. To view the raw data, use a magnifying glass. Fingerprint overhead projector slides should be in different colours or pattern recognition techniques used. Spread sheet printing should be used to insert rows of extra data.

extraction they were taught in the 1920s in America. Newer generations had not been raised this way, and so the insistence on extractions went too far in the 60s and 70s in this country. This may explain how the pendulums can sweep too far if a profession follows a paradigm in a 'cook book' way.

Highlighting all variables or factors

For a definite *case against paradigms* one must cite the premise by Carlson that certain observations are ignored. Such an attitude, taken too far, could bring about the demise of a practice or a profession. Not all observations have to be acted on, but they certainly need to be noted in case they indicate a trend or prove significant in the future. Several examples of questionable teaching have appeared over the years. For example, some students have been told that the choice of extractions does not matter; (Compare this with William's 1976 paper: 'The effect of different extraction sites upon incisor retraction') the force applied does not matter; retention does not matter; and even that the profile does not matter.

Computer programs that are not carefully planned or structured are cheekily called 'spaghetti' programs (Grouse 1986b). One wonders how much orthodontic research or treatment planning for that matter, could justifiably be termed spaghetti research or treatment planning. To follow the analogy further, structured programs, such as Pascal, demand that all necessary factors or variables must be documented at the outset.

Theory versus practice

Good theory, again by taking all variables or details into account, need not conflict with practice. Because many clinical truisms are so obvious to the clinician, they may not be documented in the formal literature.

To give but one example - theory should take into account the dimension of time, and its ramifications. It would be poor theory to say categorically that space maintainers maintain space. If a deciduous second molar is lost in a crowded mouth at seven years of age, a space maintainer may last for several years, but the chances of it lasting five years are remote. Even less likely to succeed is a chin cup to be effective in a male with prognathism at 4 years of age. The chances of the individual wearing it until cessation of mandibular growth in adulthood is quite unlikely, especially if rashes occur on the chin every summer. Wearing of any appliance, 'functional' types included, beyond five years is most unlikely for the average patient.

Clinical paradigms

Occlusion

Several schools of thought are recognised in the orthodontic world regarding occlusion. However, there is general agreement about the position of the condyle in centric relation. There is also general agreement that this position cannot be determined solely by radiographs. From this point on the disagreements start. The gnathologists insist that centric occlusion should be the same as centric relation but, whilst others say this is desirable, they also say it is not necessary. One school represented by Jankelson (1984), Callender (1984) and Lewin (1985), suggests centric occlusion should be determined by electromyography. These differences have been discussed at length in the orthodontic literature.

However, non-orthodontists may not appreciate the subtle effects of growth on balancing (or non working) side interferences. The palatal cusps of the upper second molars are the ones that deserve most consideration in this regard. One sees the occasional patient who has such a sensitive apparatus that such interferences will cause TMJ symptoms during orthodontic treatment. The majority, however, will tolerate this situation during treatment, despite the presence of the interference of the palatal cusps. The situation may last for some time due to the lack of space for the rapid eruption of the upper second molar as it tips in from a buccal aspect. The gnathological school of thought says that these upper second molars must be banded to apply buccal root torque in every instance. Other clinicians say that, with growth, the molars are able to come into a better relationship and that the occlusion adjusts this situation. Possibly another factor that should be taken into account, apart from the potential growth, is the hypermobility of joints as mentioned earlier in this newsletter. In the mature individual, Clifford Fox's 'Rule of thirds' may apply.

As for incisal guidance, Di Pietro's (1971) findings should apply. His finding was that brachyfacial types tended towards posterior disclusion whilst dolichofacial types tended to have group function.

On top of this, there is disagreement about how to assess patients, even for equilibration. Dr Ronald Roth, in a recent course in Melbourne, made the comment that 'the mouth is a poor articulator.' This conclusion was reached from observations of using repositioning splints on a routine basis. Those who use electromyography would also agree that a casual clinical assessment is insufficient. To help resolve at least some of the differing paradigms in this area, it could prove beneficial if an experienced practitioner from the gnathological group set up a series of visits with a competent practitioner of the EMG group to thoroughly compare their methods and observations.

It would be of great benefit for diagnosis and monitoring if all cephalometric films were taken in centric relation, as well as in a natural head position. One wonders, however, if the cephalostat ear-rods would have an undesirable effect on the position of the condyles in a proportion of patients.

It would seem that the various paradigms of occlusion should be subservient to a diagnostic model which includes a means of including growth, facial type and relaxed musculature. The model should also encompass the interesting X-occlusion and the helicoidal plane of occlusion, both of which change with age (Richards, 1983).

Extraction versus non-extraction

The opposing paradigms of extraction and non-extraction therapy has largely been resolved by the use of the visual treatment objective (VTO) system. There will probably always be some difference of opinion on the profile but this is frequently determined by the milieu in which the orthodontist works. General opinion amongst orthodontists nowadays is that one should guard against excessive retraction of the teeth. This is highlighted in the follow-up period wherein Holdaway (1983) states that it may take up to five years for the thickness of the lips to follow the movement of the tooth in a one to one ratio. Most other studies, for example, Oliver (1982) have tended to measure the retraction of the lips at the end of orthodontic treatment. Other studies have shown that the general population prefers fuller lips than orthodontists do (Foster, 1973) (Prahl-Anderson et al, 1979).

Since the dentition effects the lip profile in the longer term, it is important to place the dentition in the correct place for the longer term effect. This is particularly important in extraction therapy where by the teeth invariably move distally in relation to the symphysis several years out of treatment. Another interesting long term effect following over-enthusiastic extraction therapy is the post-treatment distalisation of the apices of the lower incisors, contrary to the premise of Fletcher (1981, p47) which insists that there is a 'readjustment of the lower incisor apical position towards the labial in all cases, other than perhaps Class III occlusions.' It is tempting to speculate that the transeptal fibre system has an influence on this phenomenon. Both these phenomena bring up the important principle in relation to extractions and that

is that each practitioner ought to periodically study a sample of his cases five years out of treatment, if this is not done on a routine basis. These premises contrast with the paradigm of mesial migration (Begg, 1965) which is based on clinical observations. This paradigm based on short term observations (Mills 1968) is also of questionable validity.

Stability of proclination of anteriors

Apart from circumstances such as growth, and Class III cases, periodically one sees a patient whose profile would benefit from proclination of the anterior teeth. Usually such treatment is fraught with generalised stripping of the anterior gingivae. Ricketts (1986) has found a mass of collagenous tissue in a number of individuals which he removes in the so called 'quadratus operation.' However, it seems to be limited to adults. Some younger patients also require loosening of the lips. These may respond better to degloving or sulcus deepening surgery (Hamula, 1970) associated with lip bumper therapy to prevent or minimise adhesions.

Conversely, some lips which are overly thick due to fat deposits may be amenable to micro-liposuction techniques.

The theme of this paper is exemplified by one arch extraction of first molars as advocated by Williams (1979). The best way to get into trouble is to use a probabilistic approach i.e. my next treatment plan tomorrow will be extraction of upper first molars. To consider such a treatment plan one must look at features such as anchorage requirements, size of roots of upper second molars, genuine non-extraction in lower arch and especially the over-bite. In some circumstances which require upper intrusion, it may even be prudent to have the upper first molars extracted after the intrusion. As well as upper first molars for Class II, lower first molars may be the teeth of choice for extraction in Class III cases, *again after all the variables are evaluated.*

Another approach in *selected cases* is that of reducing tooth material other than by extraction. Dr Begg advocated this many years ago but the procedure needed formalising. Sheridan (1985) has presented a comprehensive technique whereby posterior teeth can be reduced in mesio-distal width. This technique is gaining popularity in Sydney. It is a time consuming and exacting procedure which is probably better done by a competent general practitioner. The Peck and Peck procedures are well documented (Wallman, 1980).

The orthopaedic/orthodontic relationship

There has been an assumption that the forces for orthopaedic effects are greater than those for orthodontic effects. Such assumptions may be based on a certain age group. Certainly, one can see orthopaedic effects with very light headgear forces at a young age. From such observations, one is tempted to consider that orthopaedic effects are achievable with light forces via headgears and functional appliances in the mid-growth (juvenile) period. However, there have been a considerable number of young adult female patients presented at Begg meetings who show orthopaedic effects from light Class II elastics. In other words, as a profession, we *may be asking the wrong question regarding orthopaedic effects.* That is, rather than considering force values, we should be looking for indicators of good response. It will more likely prove to be a physiological indicator rather than an anatomical indicator. The responsibility for guiding researchers in this field lay with clinicians who should document features of patients who respond well in an orthopaedic way. Furthermore, an accepted clinical principle, particularly from those who use functional appliances, is that orthopaedic response is due to 'a little here and a little there'. On the other hand, as McNamara (1985) has pointed out, regarding functional appliances, whilst the mandible may grow in adults, there may be sufficient mandibular rotation to move the symphysis distally. Thus appropriate methods of analysis must be developed along the lines developed by Baumrind et al (1980). Their finding, that cervical headgear was associated with growth of the mandible leads to two thoughts about paradigms. Firstly, observations such as this should not be discarded, particularly if they are confirmed by other workers. Secondly, a blindly rationalist approach would not even look for such unforeseen phenomenon. The 'tell it as it is' existentialist approach is probably more relevant to biological studies.

The epigenetic hypothesis

The slavish application of the epigenetic hypothesis to all treatment is not prudent. Apart from the practical considerations of cost-effectiveness of treatment, schooling, social considerations etc. there appears to be a *need to differentiate between the different groups of muscles.* Certain muscles, such as the tongue, are more adaptable at a younger age than at an older age. One sees this in treating non-skeletal open-bite cases at various ages. The same principle applies to those muscles that close the jaw in the saggital plane. It is commonly accepted that a posterior crossbite corrected at eight years of age is much easier to stabilise than a similar one in an adult over thirty years of age. To these two groups of muscles the epigenetic hypothesis appears valid. But the hypothesis does not always seem to be valid for lips, particularly those that are tight. Only time will tell whether it may be more practical to treat tight lips like prognathism, that is, wait until the patient has grown, and then have surgery done. With regards tight lower lips, the presence of a yellow collagen-like tissue as described by Ricketts in adults is not so readily visible clinically or during surgery in younger patients. Undoubtedly, careful selection will be the key to the management of soft tissue phenomenon.

On the lighter side, the ultimate appliance to exploit the epigenetic hypothesis would be the facetiously called 'intra-uterine headgear'.

Tipping, translation and round tripping

In general, most orthodontic techniques do not have serious problems controlling anchorage in brachyfacial types. But to do this, many traditional techniques perform 'round tripping'. The Tweed anchorage preparation involves round tripping in the mandibular arch. The Begg technique uses bimaxillary anchorage preparation and thus round trips in both arches. Other techniques use round tripping at some stage.

In dolichofacial types, however, the various techniques employ a number of combinations to overcome the problem of mandibular rotation while conserving anchorage. For the purposes of this discussion, we shall disregard those patients who have given the orthodontist the opportunity for earlier treatment whereby part time wearing of headgear or function appliances allows some recovery of mandibular rotation each day. One approach is to use high pull headgear on the upper posterior teeth which provides an intrusive component to the upper molars while supplementing the anchorage. This can be applied to fixed appliances or it may be more controllable with functional appliances (Heath, 1985). Another approach uses neither heavy intra-oral anchorage conservation techniques nor extra-oral anchorage help. These practitioners rely heavily on extractions in both Edgewise and Begg practices. The virtual absence of tip back bends is their solution to the problem of mandibular rotation.

Also, to a much lesser degree, the paradigms of tipping movement versus translation movements do not conflict as much as the neophyte would think. Due to the binding of the archwires, some so-called tipping movements may commence with translation; and similarly, the so-called 'bodily movement' is really a series

of tipping and uprighting movements. However, in practice, one sees situations where it is appropriate for a tipping exponent (Begg) to use translation e.g. simple closure of a diastema; and where a translation exponent (Edgewise) needs to tip a tooth to reduce an excessively proclined tooth. For the former situation, the Begg practitioner may use T-pins* or turn the brackets sideways: for a tipping situation, an Edgewise operator may use a round wire or place the appropriate part of the arch wire in the electrolytic polisher.

The point is, if one follows the dogma of a technique, which is prudent early in one's career, the reasons should be understood so that the need for genuine exceptions are recognised. As for bracket type, it is quite wise to adhere to one's favourite on the grounds of simplicity of stock control. Not only does this make practice management simpler for the clinician, but also for his staff. Thus many factors go into the choice of this rather technical sub-paradigm.

The cant of the occlusal plane

There have been generally two views on the importance of maintaining the cant of the occlusal plane. One school feels that it is very important, the other school says that it will settle back after treatment and that this is not important in any case. Long term follow-up studies are required by both schools of thought. But there is already sufficient evidence to make some relevant comments. Firstly, different facial types will respond differently. Secondly, the age of the patient is significant, particularly if one relates the occlusal plane to Xi point. Therefore, any study of this area should take these variables into account.

Thirdly, there are different opinions on the mechanics involved. One often stated premise is that Class II elastics will affect the cant of the occlusal plane. There are three variables which ought to be taken into account in such a statement.

(a) The force of the elastics is important in the opinion of many clinicians. Currently, in Begg therapy, the force values are limited to one or one and a half ounces. To achieve these low force values, it may be necessary to have patients stretch two ounce elastics before they are inserted when new. Such an opinion is in marked contrast to those who recommend six ounce forces for intermaxillary elastics.

(b) The positioning of the elastics is also thought to be important. Some practitioners go to the trouble of attaching hooks to the distal of the molar bands to keep intermaxillary elastics as horizontal as possible. If this is important, it could be a pity that Dr Begg's original design of incisally positioned elastic hooks on the upper arch was reversed upwards. In the past, Edgewise hooks were soldered to the incisal of the archwire. This is in marked contrast to new devices which have hooks quite high above the cuspids. Furthermore, some practitioners have the distal part of the intermaxillary elastic coming from the lower premolar region. This would provide a predominently vertical force, but the rationale for these is that the lower molars, particularly the lower second molars, are not elevated. Undoubtedly, modifications to the Herbst type mechanism will appear on the market with lighter forces and elbows to keep the forces as horizontal as possible. Intermaxillary magnetic force mechanisms are appearing on the market with this principle in mind.

(c) Whilst the two factors above are important, it could prove that an over-riding factor is the type of face, that is, whether it is brachyfacial or dolichofacial.

There is one matter which is of some significance to the cant of the occlusal plane and applies to the evaluation of many papers on orthopaedic appliances. This is the physical fact that a centre of resistance of teeth or jaws is not a valid concept. In both cases, they should constitute a line of resistance, or more precisely, a line of rotation. Authors who use the term centre of resistance may be influenced by the term centre of mass. Teeth and jaws are in both a constrianed and dynamic system. Those wishing to undertake studies in these two areas should seek the best available advice from a physicist.

Finishing

There are two general schools of thought regarding finishing. One is that the teeth should be precision finished. The other is that allowance should be made for settling or rebound. Only the most fastidious clinicians take either of these concepts to their ultimate conclusion. For example, those who believe that teeth should be overmoved and allowed to settle, should over-torque all upper second molars with buccal root torque to allow the lingual cusp to settle back. As well as this, many Begg practitioners do not incorporate overmovement in the heavy base third stage arch wires even apart from those who offset their brackets for rotation. On the other hand, many highly regarded Edgewise practitioners seek overmovement by the end of the fixed appliance phase.

An important consideration in relation to overmovement is the time or duration of treatment. Suppose, for example, a single rotated lateral incisor is the only tooth requiring correction within the whole dentition, it would be prudent to overmove this tooth if it were derotated quickly within several months, even if pericision was used. Angulated stripping is prudent for short term purposes only.

Resorption theories

One paradigm that needs constant revision is that of the causes and management of root resorption. A former hypothesis documented by Graber, (1966) was that it was related to heavy and medium continuous force. More informally, other hypotheses were that resorption was related to jiggling, both occlusal and orthodontic, and vertical movement. Others suggested that it was related to retaining cases which were unstable. As part of all these thoughts was the obvious assumption that different patients responded individually. Due to new therapies being instituted in recent times, a more comprehensive model may be developed.

Firstly, it may be wise to consider exactly what one means by a model and how one is developed. Rather than a categorical over-simplified statement, a model ought to be far more specific. That is, it could take a number of dimensions and specifications into account. For example, a model may say that resorption may occur in such-and-such a case at such-and-such a time, with such-and-such a movement etc. The Busan-type 'brain dump' as mentioned in a previous Editor's Newsletter (October 1984) lends itself nicely to developing such a model. Secondly, one needs to be more specific in what constitutes light forces. In fact, for the new braided wires and fine high tensile wires (e.g. .009 inch) it may be appropriate to use the term *ultralight.*

Other new developments relevant to this discussion are Rickett's 'Squeeze therapy' and the use of magnets in orthodontics (Dellinger, 1986). It is a common observation that root resorption is related to anterior vertical elastics. However, this ought not to blind us to the fact that it may be possible to close open bites orthodontically with a correct technique. Possibly one could consider the heavy forces used in the Squeeze technique as vertical orthopaedic forces which may or may not bend the bone initially. Certainly the procedure is remarkably similar to reducing mandibular fractures. Its biggest benefit would not only be that it is quick, but rather that it is not a jiggling procedure. Magnets also produce a continuous force compared to the jiggling which may often be associated with traditional anterior box elastics which are taken off for eating and possibly speaking. A further advantage of magnets is that they may be able to achieve an intrusive effect on the

*T.P. Laboratories Inc. Indiana 46350, U.S.A.

posterior teeth while simultaneously attracting the anterior teeth.

The 'resorption model' should also take into account the strange observation that there seems to be a changing incidence of resorption in that it is becoming more common amongst boys. Typically, the old adage was that one should beware of root resorption in a young female with a turned up nose. The other interesting, and far less common observation, is that, although tooth ankylosis is a very rare condition, it frequently seems to be associated with resorption in the teeth. Such observations are tempting to hypothesise that resorption is a metabolic disturbance although the various biochemical studies done to this time have proven fruitless.

A stratagem for closing open bites non-surgically must consider those appliances aimed at developing the mandibular elevator muscles, as suggested by Mizrahi (1985). The problem with these types of appliances at the moment is fracture of the springs but this should be able to be overcome by consultation with a metallurgist.

Non-clinical paradigms

Research

A major problem with much of the orthodontic research in the past is that researchers have looked to the physical sciences for their models. In the clinical situation, in particular, there are a number of restraints. Firstly, it is rarely possible to randomise the variables for unbiased studies. Secondly, there are ethical restrictions. Not only are there justifiable rules, such as minimising radiation to patients, but limitations have been imposed on animal experiments such that, even if the work was carried out, scientific journals would not publish it unless the experiments had been passed by an Ethics Committee.

As well as these restrictions, one can seriously question whether statistical methods used in the physical sciences are always relevant to biological research. This author has previously discussed this point in relation to a form of statistics based on mode and bimodal phenomena (Mollenhauer, 1985). Certainly the statistical world has realised the importance of looking at features other than means and standard deviations by developing Exploratory Data Analysis, which was discussed earlier in this Newsletter.

Just as importantly, even where methodology is borrowed from other disciplines, there has been a tendency to use it in a superficial or 'cookbook' approach. Such approaches usually result from a lack of time to discuss, in depth, what the researcher really wants from other disciplines. An excellent example of the new paradigm, on the other hand, is the article by Hazel and West. Many hours were taken to explain the clinical requirement of orthodontic wires to the metallurgical expert, instead of reading the past literature and casually accepting the old assumptions and tests.

As a discipline, we have not made it clear to statisticians that 'outliers' are important to clinicians. The term 'dirty data' is applied to data points which do not fit in with the rest of the pattern. Some data points are inaccurate because of poor readings. For the mathematical cognoscenti, a new geometry using computer-search techniques (Kreber and Radziszowski, 1986) may construct programs for error reduction. *But rather than have residuals treated in a mathematical way, the researcher should return to the original material and gather further data to see if there are real reasons for these outliers.* This may be easier in the clinical situation than laboratory experiments where, for example, the origins of the extracted teeth may not be known. Such information could be important in experiments on bonding. If the adhesive strength was different for several teeth, it could be valuable to know if the teeth came from a juvenile or an adult, a fluoridated area or not, how the teeth were preserved etc. Surely one of the great lessons in dental research was Langeland's (1958) studies showing that reticular degeneration of the pulp was an artifact created by the handling of the specimen. That one paper created a completely new paradigm in pulpal studies (Ogilvie and Ingle, 1965) by showing that one can create reticular degeneration at will. A more recent investigation by Eriksson (1982), cited by White (1985) may also undermine previous paradigms on TMJ pain. In an endeavour to control variables in experimentation, a number of customary methods have been devised for bonding research and these undoubtedly require study. Firstly, there is the practice of cutting away the external surfaces of the enamel to create a flat surface to make all specimens uniform. While this may prove to give accurate measurements, the validity of the practice needs to be confirmed. Even more important is the practice of putting large weights on the bonded specimens until set. In the clinical situation, there is a limit to how much weight and how long it may be applied to the tooth. Also, the surface of the tooth being bonded is often more vertical than horizontal. All these factors make 'rebound' harder to control. In conclusion, the old paradigms of research methodology based on precedent alone need to be reviewed by testing the instrumentation in the first instance. Students, in particular, need to talk to a number of experienced experts at the design stage of the research.

Research versus clinical bias

As well as randomisation to reduce bias as discussed in a previous Editor's Newsletter (Vol 9 No 1, 1985), methods could be introduced into orthodontic teaching programs which would highlight the need for error analysis in the clincial situation. Students not infrequently state that they need to do again tracings done earlier in the course. These experiences, and especially those from supervising research, emphasise to orthodontic teachers and tutors the need to evaluate their own tracing consistency and therefore validity. Since it does not require chairside time to retrace several films, this is a convenient exercise in error analysis. However, other procedures could be investigated in terms of *quality control methods,* which is the practical application of research bias prevention in industry. A clinical example would be the immediate removal of randomly selected archwires to evaluate the distortion due to the clinician's method of archwire fixation.

That is, protocols developed for research to enhance unbiased conclusions could be adapted to clinical procedures for teaching the protocols and to provide practical advantages.

Teaching

For the sake of uniformity of teaching, a University department usually falls into one of two general categories, and therefore paradigms. One approach is to have an objective academic outlook compared to a subjective clinical approach. Ideally, both approaches should occur within each teaching department. There should be a critical and objective review of all articles and schools of thought, but, to encourage mastery of clinical procedures, enthusiasm is a helpful ingredient. For example, not only is the pursuit of excellence in tracing desirable, but it can actually make a complete difference in treatment planning and validity of monitoring. Valid tracing techniques require several ingredients. Apart from a good tracing environment, with study models and darkened room, one requires good radiographic films. It is not uncommon to see inadequately exposed films where the condyles, porion and even the ear rods cannot be discerned on the film. The worst form of radiation hygiene is to have poor radiographs in the first place which require re-taking. Also, lower KV ratings are more harmful to the skin. Cephalometric radiographs should be taken with a minimum of 90 KV. Of some importance is the target-film distance - it can be more difficult to trace

certain features, such as the condyles, if the target-film distance is too small. The other important ingredient is the consistency of the tracing technique as previously mentioned.

Another problem in teaching is expressed by the old axiom 'Jack of all trades and master of none.' Nevertheless, in orthodontics, it can be advantageous to have a sound working knowledge of other techniques.

Literature

As well as the articles with quantitative data from controlled research, there are two other forms of papers which need to be differentiated. Unfortunately, both tend to be grouped together as anecdotal, whose overtones tend to be derisive. Undoubtedly, there are papers which quite correctly could be called anecdotal. But there is another area of research which ought to be explored by orthodontics and this is formal Qualitative Research discussed in an earlier Editor's Newsletter (March 1984).

Yet another area, which will be discussed in a future Newsletter, is Cognitive Science. Both of these approaches complement Quantitative Research nicely.

In conclusion, this has been a very superficial coverage of some of the components of recent paradigms in orthodontics. To some degree, the term has been used similarly to the word paradox. ***Like paradoxes, the differing paradigms need to be resolved.*** The examples given indicate that this may be possible by communication and familiarity with other paradigms; and ***to move towards careful selection rather than using over-generalised 'cookbook' approaches.*** The eventual findings must be rational and practical, exemplified in a statement by Solberg (1986).

'Temporomandibular disorders represent a curious combination of psychological and somatic manifestations, yet the inclusion criteria for the 'case definition' are dependent upon physical findings. The signature of the TM disorder is pain provoked by function.'

The ultimate aim of this segment on 'paradigmless orthodontics' is to stimulate serious thought and discussion.

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Yours sincerely,

Barry Mollenhauer

REFERENCES

ACKERMAN, M. (1986)
Hilbert curves made simple
Byte - the small systems journal. 11(6):137-138
BAUMRIND, S. and MILLER, D. M. (1980)
Computer-aided head film analysis: the UCSF method
Am. J. Orthod. 78(1):41-65
BEGG, P. R. (1965)
Begg orthodontic theory and technique
Philadephia: W. B. Saunders Co.
BDJ LEADER, (1986)
Dental research under scrutiny; and The Butterfield Report - the right foot forward
BDJ 160(8): 263-264
CALLENDER, J. M. (1984)
Orthodontic application of the mandibular kinesiograph
J. Clin. Orthod. 18:(Nov) 791-805
CARLSON, D. S. (1985)
Craniofacial biology as 'Normal Science'
IN: New Vistas in Orthodontics, Ed: Lysle E. Johnston
Philadelphia. Lea & Febiger
DELLINGER, E. L. (1986)
A clinical assessment of The Active Vertical Corrector
Am. J. Orthod. 89(5):428-436
DI PIETRO, G. J. (1977)
Study of occlusion as related to Frankfurt-mandibular plane angle
J. Pros. Dent. 38:452-458
ERIKSSON, P. O. (1982)
Muscle fiber composition of the human mandibular locomotor system
Swedish Dent. J. Suppl. 12:8-38
EWEN, S. T. and PASTERNAK, R. (1964)
Periodontal surgery - an adjunct to orthodontic therapy
Perio. 2:162-171
FLETCHER, G. G. T. (1981)
The Begg appliance and technique
Bristol: Wright - PSG
FOSTER, E. J. (1973)
Profile preferences among diversified groups
Angle Orthod. 43:32-40
GRABER, T. M. (1966)
Orthodontics: Principles and Practice
2nd Ed: Philadelphia. W. B. Saunders Co.
GROUSE, P. (1986a)
Exploring the Mandelbrot Set
Your Computer. January 1986
GROUSE, P. (1986b)
How to write a structured program - Part 15
Your Computer. August 1986
HAMULA, W. (1970)
Surgical alterations of muscle attachments to enhance esthetics and denture stability
Am. J. Orthod. 57:327-369
HEATH, J. R. (1985)
Maxillary control with functional appliances: some clinical observations
Aust. Orthod. J. 9(2):219-225
HOLDAWAY, R.A. (1983)
A soft tissue cephalometric analysis and its use in orthodontic treatment Part 1
Am. J. Orthod. 84:1-28
JANKELSON, (1984)
3 dimensional orthodontic diagnosis and treatment: A neuromuscular approach
J. Clin. Orthod. 18(Sept):627-640
KREHER, D. and RADZISZOWSKI, S. (1986)
Cited in 'Microbytes': New geometry could have implications for telecommunications
Byte - the small systems journal. 11(6):9
KUHN, T. S. (1970)
The structure of scientific revolutions
2nd Ed: Chicago, University of Chicago Press
LANGELAND, K. (1958)
Tissue changes in the dental pulp: an experimental histologic study
Odont.Tskr. 65 (Aug): 239-385
LEWIN, A. (1985)
Electrognathographics: Atlas of diagnostic procedures and interpretation
Chicago: Quintessence Publishing Co.
MIZRAHI, E. (1985)
Positive intermaxillary pressure appliance
J. Clin. Orthod. 19(8):579-582
MCLEAN, A. L. (1986)
The concepts and practice of statistics
Aust. Orthod. J. 9(3):282-284
MCNAMARA, J. A. (1985)
The role of functional appliances in contemporary orthodontics
IN: New Vistas in Orthodontics; Ed:Lysle E. Johnston
Philadelphia. Lea & Febiger
MILLS, J. R. E. (1968)
The stability of the lower labial segment
Dent. Prac. 18:293-305
MOLLENHAUER, B. (1984)
A comparison of quantitative and qualitative research design (Editor's Newsletter)
Aust. Orthod. J. 8(3):104
MOLLENHAUER, B. (1985)
Need for a new branch of statistics (Editor's Newsletter)
Aust. Orthod. J. 9(3):295-298
MOSS, M. (1983)
(Guest Editorial) Beyond roentgenographic cephalometry - What?
Am. J. Orthod. 84(1):77-79
OGILVIE, A. L. and INGLE, J. I. (1965)
An atlas of pulpal and periapical biology
Philadelphia: Lea & Febiger
OLIVER, B.M. (1982)
The influence of lip thickness and strain on upper lip response to incisor retraction
Am. J. Orthod. 82(Aug):141-149
PRAHL-ANDERSON, B., BOERSMA, H., VAN DER LINDEN, F. D. G. M. and MOORE, A. W. (1979)
Perceptions of dentofacial morphology by lay persons, general dentists and orthodontists
J. Am. Dent. Assoc. 98:209-212
RICHARDS, L. (1983)
Cited in Editorial Australian Begg Newsletter. Ed. B. Mollenhauer
Aust. Begg Study Group October 1983
RICKETTS, R. M. (1986/7)
Am. J. Orthod. (in publication)
SEWARD, F. S. (1968)
Frankfort horizontal plane, facial angle and facial type
Aust. Orthod. J. 1(4):1-6-108
SHERIDAN, J. J. (1985)
Air-rotor stripping
J. Clin. Orthod. 19(1)43-59
SOLBERG, W. K. (1986)
Temporomandibular disorders: physical tests in diagnosis
BDJ 160(8):273-277
VELLEMAN, P. F. and HOAGLIN, D. C. (1981)
Applications, Basics and Computing of Exploratory Data Analysis
Boston,Ma: PWS Publishers (Duxbury Press)
WALLMAN, R. (1980)
Utilising the Peck and Peck analysis in reproximating lower incisor teeth (Clinical Aids)
Aust. Orthod. J. 6(4):198
WHITE, L. W. (1985)
The lateral pterygoid muscle: fact and fiction
J. Clin. Orthod. 19(8):584-587
WILLIAMS, R. and HOSILA, F. J. (1976)
The effect of different extraction sites upon incisor retraction
Am. J. Orthod. 69(Apr):388-410
WILLIAMS, R. (1979)
Single arch extraction - upper first molars or what to do when non-extraction treatment fails
Am. J. Orthod. 76(Oct):376-394