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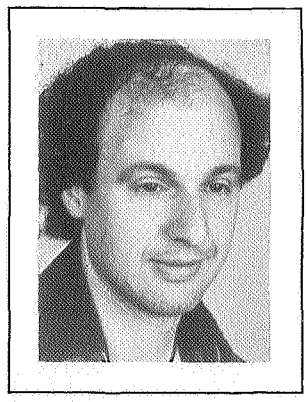

# Trauma to the permanent teeth

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**Abstract:**
Trauma involves approximately 12% of endodontic problems, and the upper central incisor is the most common tooth involved. Great care must be taken in trying to ascertain the extent of the injury, the vitality of the pulp, the colour of the tooth and the on set of calcific obliteration of the pulp canal space. These are the keys to successful treatment should it be required. This applies equally well to enamel fractures right through to transverse root fractures and avulsion of teeth.

**Reference:** Aust. Orthod. J. 9(2) 238-242 (1985)

**Key words:** trauma, incidence, endodontics, orthodontic extrusion

## INTRODUCTION

Although in a way rather tragic, trauma in one form or another occurs to about 12% of patients (Andreasen, 1981) and in the main only the anterior teeth are involved. A perusal of the relative incidence of trauma to anterior teeth shows that the upper central incisors are involved 72% of the time, the upper lateral incisors approximately 12% of the time, the lower central incisors approximately 10% of the time, the lower lateral incisors approximately 5% of the time and the upper and lower cuspids taking the remaining percentage to 100%.

Of the actual injuries that occur, 21% of all trauma occurs solely with enamel injuries, 59% are dentine injuries involving the enamel also, but without pulp exposure, 13% involve pulp exposure and the remaining 7% are either transverse root fractures or avulsions of teeth (Andreasen, 1981).

Finally, one must ask, 'Where do these injuries occur?' They are equally separated into: school, home, transit, and leisure activities. ***The point of this being that whilst a mouthguard will protect against 25-30% of trauma to anterior teeth, it will not protect against the greater bulk of traumatic injuries.***

## ASSESSMENT

Consideration will be given to actual type of injury, the vitality of the tooth, the colour of the tooth and the extent of calcific obliteration of the pulp canal space.

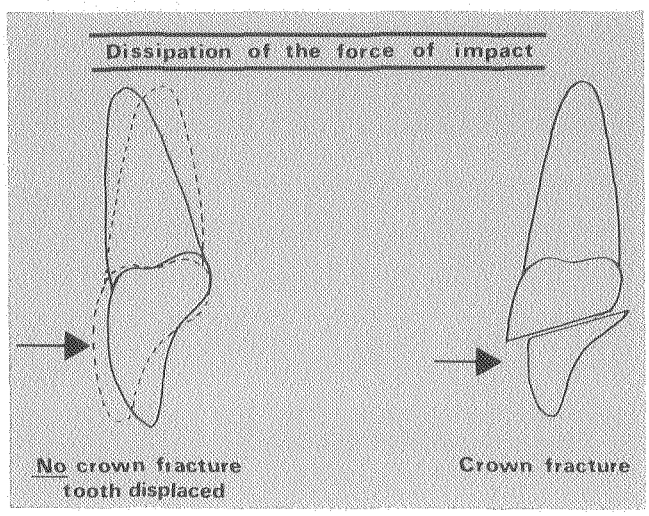


Figure 1. Teeth may be traumatized by a luxation (left) or a fracture (right)

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### (a) Type of injury

As is seen in *Figure 1* the injury to a tooth may be either a fracture or a luxation. If it is a luxation *(Figure 2),* the tooth may be either intruded, extruded or laterally luxated. The pulp response will depend on the type of luxation.

### (b) The vitality of the tooth

Many people have attempted to assess the vitality of traumatized teeth (Andreasen 1981, Jacobsen 1980, and Ravin 1981). It appears that a vitality reading is not

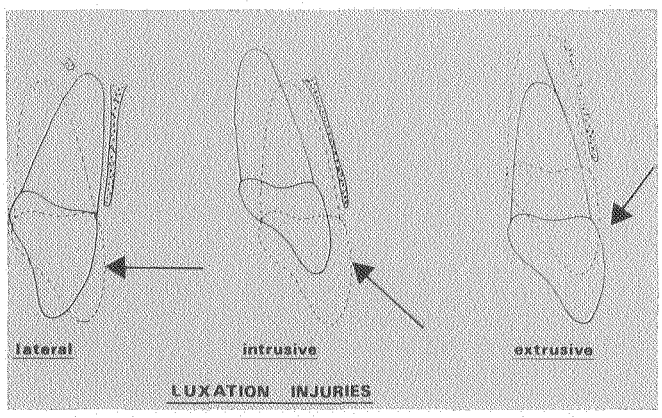


Figure 2. Luxation injuries may be extrusive, intrusive or lateral

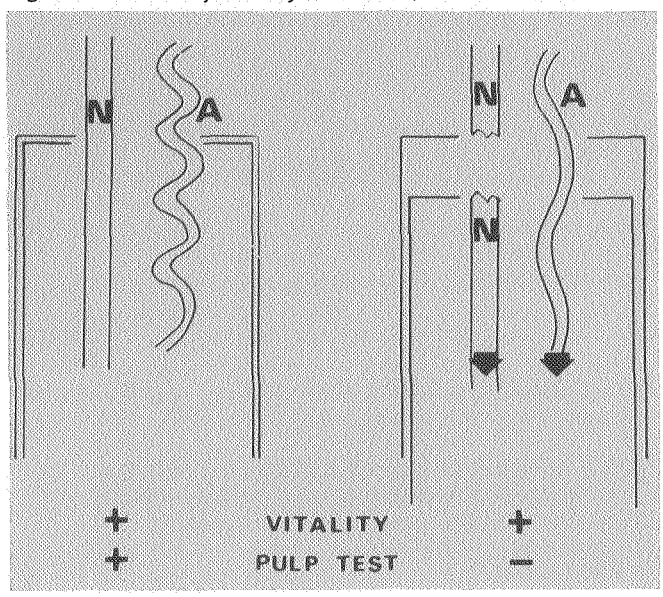


Figure 3. The blood vessels may be intact even though the nerve is severed — such a tooth is still 'vital' even though it gives no reaction to pulp vitality tests

applicable *(Figure 3)* and that approximately 70% of traumatized teeth will remain vital even though the vitality test may react in a negative manner (Jacobsen 1980), *(Table 1)*. It is also apparent that certain types of luxation injury readily give non-vital responses *(Table 2)*.

Table 1. Incidence of pulp necrosis following luxation injuries

| | | |
|---|---|---|
| Skieller | 1960 | 41% |
| Anehill et al | 1969 | 24% |
| Andreasen | 1970 | 52% |
| Stalhane et al | 1975 | 15% |

Table 2. Incidence of pulp necrosis following specific types of injury

| | |
|---|---|
| Andreasen 1970 | |
| Subluxation | 26% |
| Extrusive luxation | 96% |
| Intrusive luxation | 64% |
| Dumsha and Horland 1982 | |
| extrusive luxation | 96% |

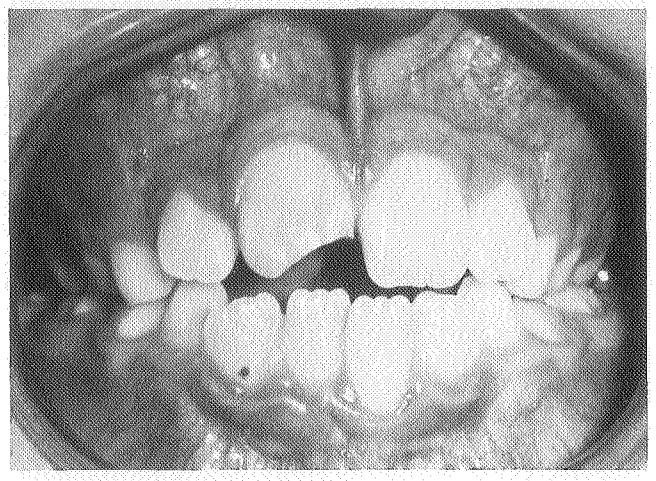

Figure 4. Discoloured tooth 11 is still vital

Figure 5. The previously discoloured tooth is still vital (a) at the time of injury (b) 18 months later

Table 3. Incidence of discolouration as a definite sign of pulp necrosis in traumatised teeth

| | | |
|---|---|---|
| Andreasen 1970 | luxation | 34% |
| Jacobsen 1980 | subluxation | 44% |
| | luxation | 39% |

Table 4. Incidence of pulp canal obliteration following luxation

| | | |
|---|---|---|
| Andreasen | 1970 | 22% |
| Grondahl | 1974 | 24% |
| Herforth | 1976 | 35% |
| Stalhane et al | 1973 | 6% |

**(c) The colour of the tooth**

Various authors have assessed the colour of the tooth (Andreasen 1981, Jacobsen 1980, and Ravin 1981) in connection with vitality but it is apparent that independent of the colour of the teeth approximately 60% remain vital *(Figure 4 and 5, Table 3)*.

**(d) Calcific obliteration of the pulp canal**

There is a great deal of argument about whether endodontics should be performed on observing a pulp canal that is obliterating. Work has been done on this topic (Lundberg 1980), *(Tables 4 and 5)* and apparently only about 7% of those pulps that have obliterated become non-vital. Microscopically even the so-called 'obliterated' pulp has a pulp canal *(Figure 6)*.

The next factor is the type of injury to the tooth

**1. Enamel fracture**

Where an enamel fracture has occurred, apart from following the vitality of the tooth and keeping an eye on any calcific obliteration of the pulp canal, the fracture surface should be smoothed off, and if it is extensive, restored with either a glass ionomer resin or composite resin.

**2. Dentine fracture**

With dentinal fractures it is apparent that the outer most portion of the pulp becomes destroyed. Therefore, the fractured dentinal surface should be covered with a calcium hydroxide lining agent and then the tooth restored. Naturally, a close watch must be kept on the vitality of the tooth as well as the rapidity of onset of any calcific obliteration of the pulp canal space.

**3. Asymptomatic pulp exposure**

The treatment goal in all traumatic injuries is to enable the vital pulp to stay vital and asymptomatic. This is especially the case with a young immature tooth where it is most important for the root canal to grow to maturation.

The asymptomatic exposure used to be treated with either a pulp capping or pulpotomy. An unknown amount of chronically inflamed pulp tissue was left beneath the pulp capping agent and pulpotomy suffered from the disadvantage that it left the gingival margin weakened and therefore likely to fracture. The majority of these problems have been overcome by the high pulpotomy technique described by Cvek (1978), *(Figure 7)*.

Table 5. Incidence of pulp necrosis following pulp canal obliteration

| | | | |
|---|---|---|---|
| Observation period | | | |
| Holcomb et al | 1967 | 4 years | 7% |
| Andreasen | 1970 | 1-12 years | 7% |
| Stalhane et al | 1971 | 13-21 years | 16% |
| Jacobsen et al | 1977 | 10-23 years | 13% |

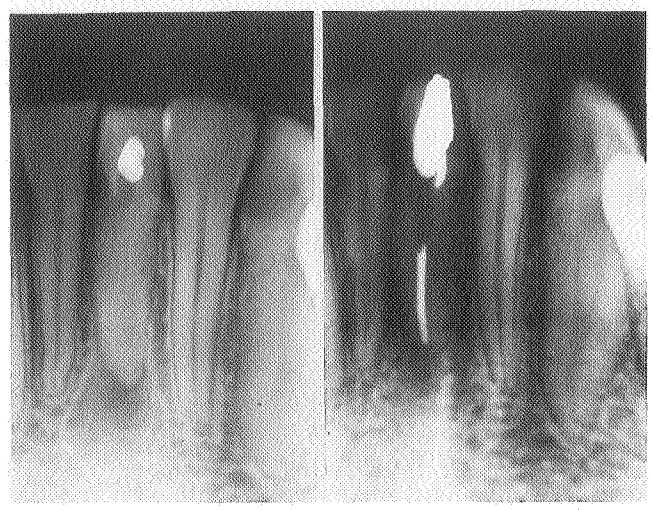

Figure 6. (a) Apparently obliterated pulp canal, seen on radiograph (b) Canal can still be found

Rubber dam is applied in this technique and the exposed layer of pulp is surgically removed with a high speed diamond bur. Once haemostasis is obtained, which may take up to 12-15 minutes, a calcium hydroxide dressing is applied on top of the pulp stump (Schroder 1972), *(Figure 8),* and the tooth restored.

Available follow-up studies show that 94-96% of these teeth stay vital without the need for endodontic therapy (Lundberg and Cvek, 1980).

### 4. Symptomatic pulp exposure

Where the pulp is vital but symptomatic, or else the pulp is non-vital, endodontic therapy must be performed. The problem where immature teeth are involved is that there is no constriction at the apex to pack the root filling against. Therefore the canal must be firstly closed or bridged over at its apex before a root filling can be performed, and calcium hydroxide therapy has been shown to be best for this (Heithersay 1965), *(Figure 9).*

When apexification is complete, which may take from six months to four years, the tooth is re-entered, the calcium hydroxide washed out and the tooth is filled using a normal root filling agent.

It should be remembered that where the pulp has succumbed at an early stage, no further lateral deposition of dentine will occur and such a tooth will be very vulnerable to fracture. The long term prognosis of such teeth is far from favourable.

It is apparent that every endeavour should be made to keep the pulp vital for as long as possible following traumatic injury to the teeth.

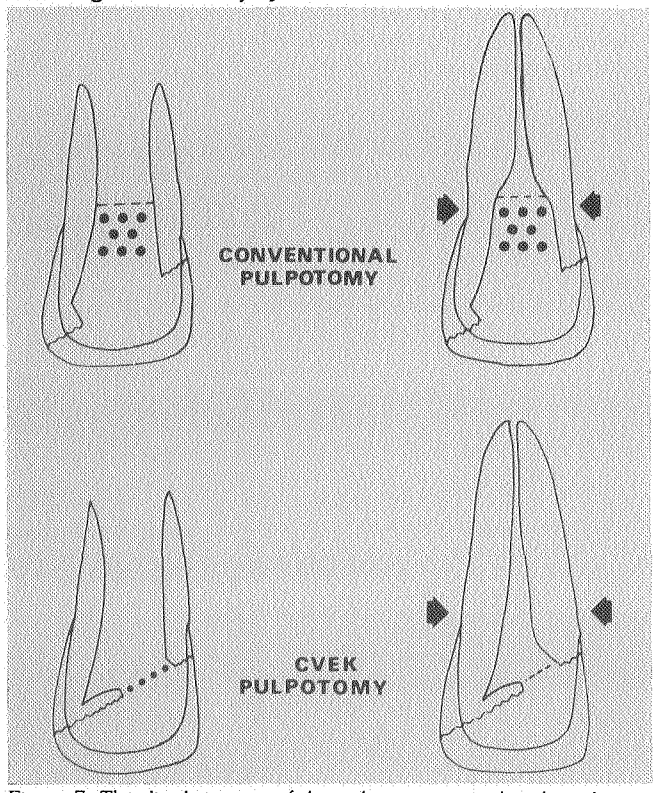


Figure 7. The disadvantages of the pulpotomy procedure have been overcome by the Cvek technique

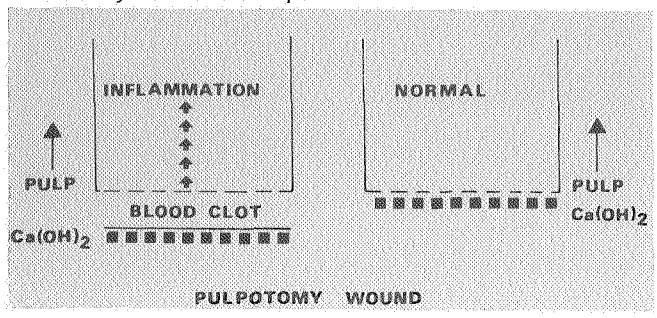


Figure 8. The importance of adequately securing haemostasis

### 5. Transverse root fractures

Sadly many teeth with transverse root fractures are mismanaged because many dentists feel that they have to do something. Treatment involves a consideration of three factors: the position of the fracture line *(Figure 10),* the vitality of the coronal fragment and the mobility of the coronal fragment (Feiglin 1981, and Jacobsen and Kerekes 1980).

(i) The position of the fracture line and mobility of the coronal fragment.

Classification of fractures can be divided into three zones. Fractures in zone one are quite easily treated by removing the crown of the tooth, carrying out (if necessary) slight gingival surgery, performing endodontic therapy and finally constructing a crown.

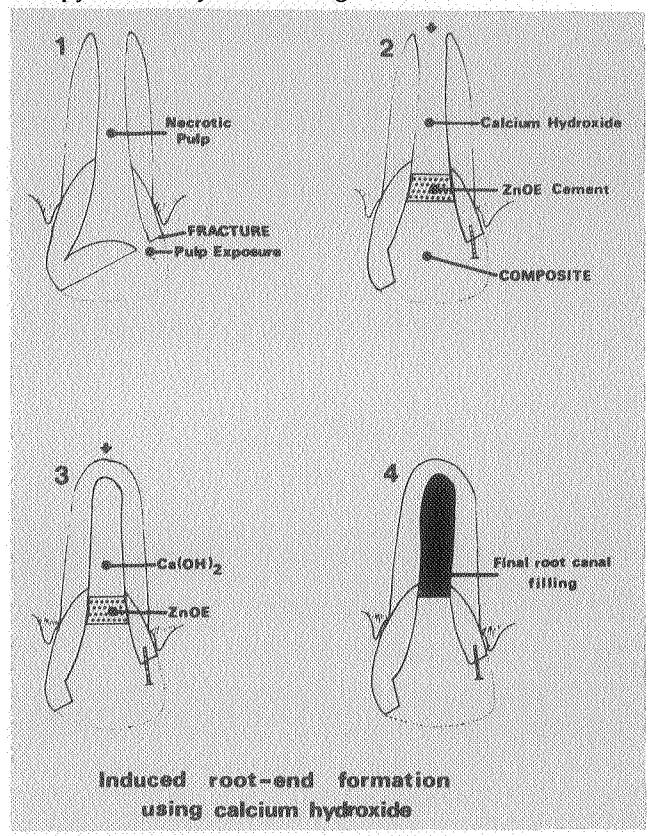


Figure 9. The technique of root end closure using calcium hydroxide

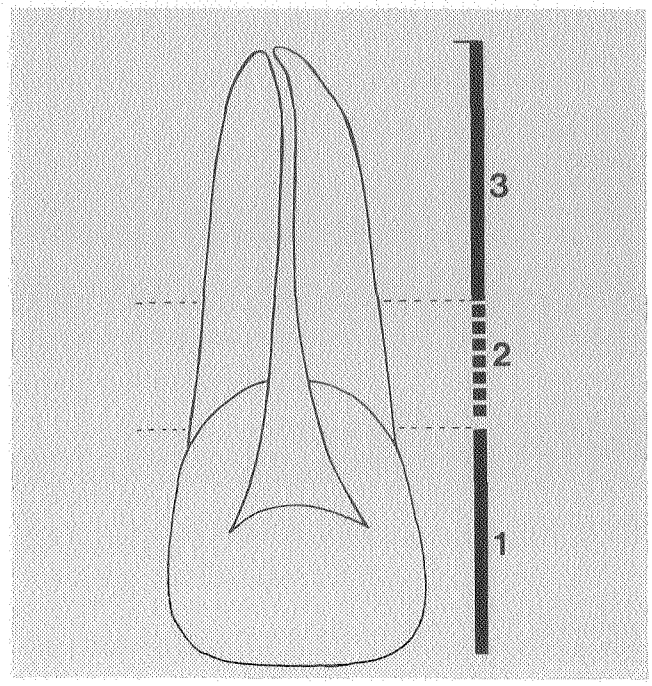


Figure 10. Transverse root fractures can be divided into one of three zones

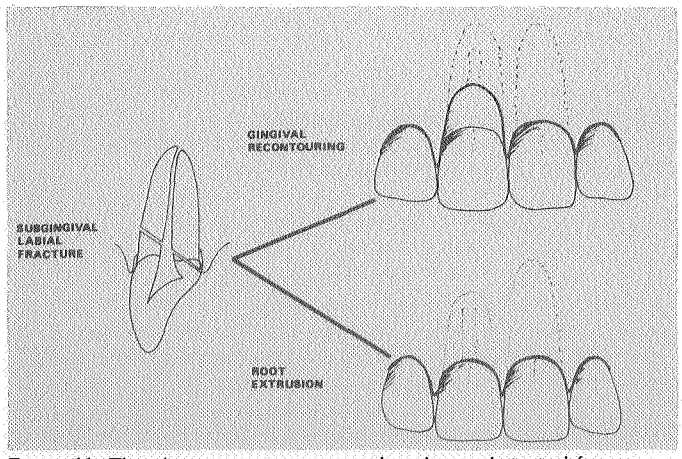


Figure 11. The alternative treatments with a deep subgingival fracture

Fractures in zone three usually require no treatment at all other than splinting for 8-10 weeks if the coronal fragment is mobile. These fractures in the main have an excellent long term prognosis.

Fractures in zone two are very difficult to manage and have the worst long term prognosis.

The coronal fragment is readily mobile and is not easily immobilized. All that is required is a small amount of apical migration for the fracture line to become contaminated with saliva and therefore the coronal fragment must of necessity be lost. The remaining apical portion, if it can be saved, lies along way below the gingival margin and attempts to expose it will create a marked cosmetic deformity *(Figure 11).*

(ii) Pulp vitality

Endodontic therapy, if undertaken, should be performed in the coronal fragment only because it is very rare indeed for the apical fragment to become non-vital. True hard tissue growth across the fracture line is not very common and from this point of view it is wise to consider the fractured segments as separate entities. Obliteration of the root canal space in the apical fragment by the deposition of secondary dentine is commonly found on long term follow up (Michanowicz 1963), *(Figure 13).*

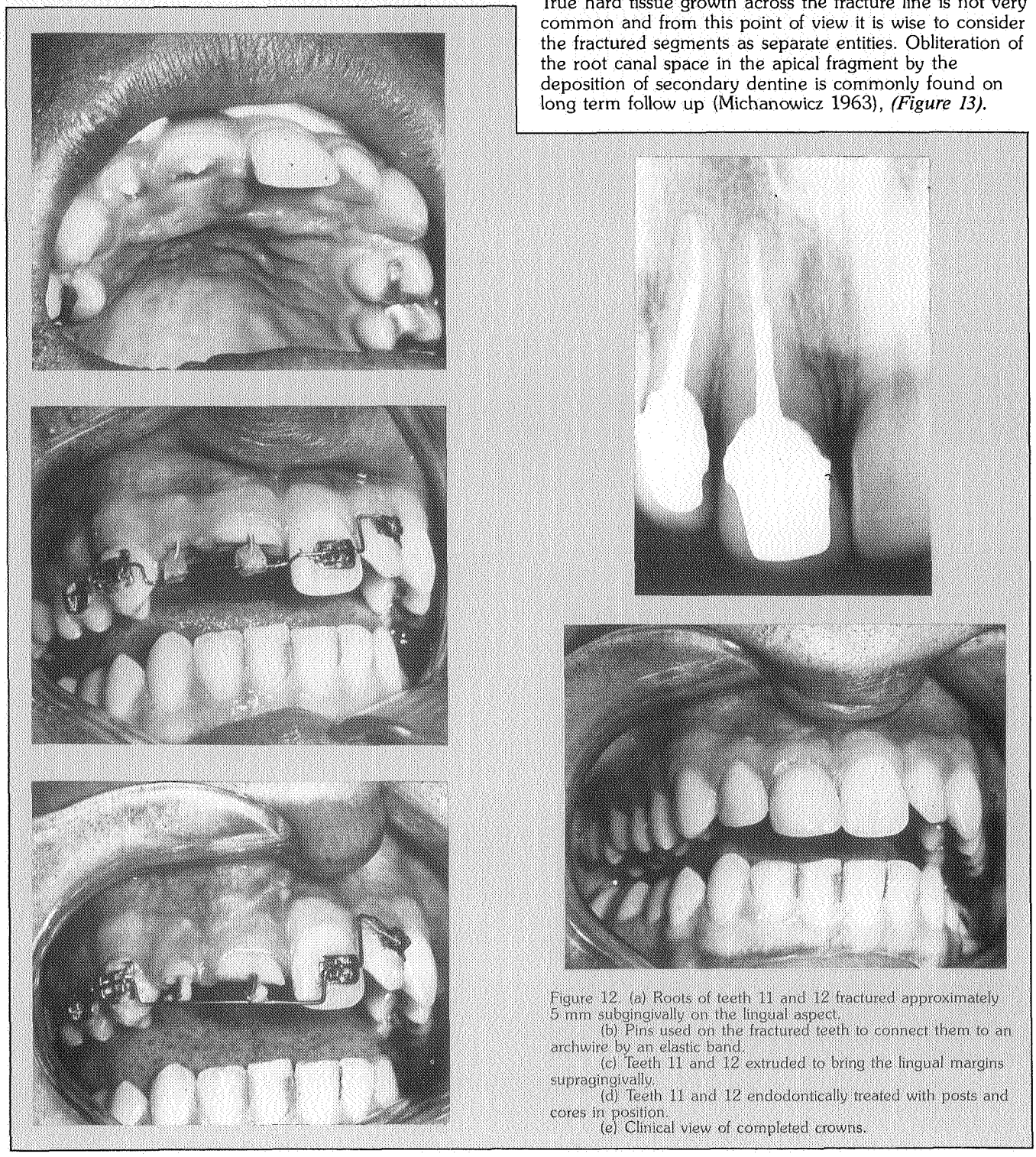

Figure 12. (a) Roots of teeth 11 and 12 fractured approximately 5 mm subgingivally on the lingual aspect.
(b) Pins used on the fractured teeth to connect them to an archwire by an elastic band.
(c) Teeth 11 and 12 extruded to bring the lingual margins supragingivally.
(d) Teeth 11 and 12 endodontically treated with posts and cores in position.
(e) Clinical view of completed crowns.

### 6. Avulsion

For many years people have been trying to identify those factors responsible for the onset of replacement (ankylosis) root resorption that so often follow the replacement of avulsed teeth (Andreasen 1981, and Feiglin 1986). It is now recognized that maintenance of a vital periodontal ligament is crucial if this disasterous type of resorption is going to be overcome.

The initiating factor for replacement root resorption is a denuded root surface to which hard-tissue resorbing cells are attracted. If this denuded zone, without periodontal ligament, is not replaced by vital periodontal ligament growing across within a certain time, then root resorption will start and unfortunately continue until the tooth is lost *(Figure 14)*. There are a number of critical points to consider.

#### (a) Storage conditions

Although it is desirable to immediately replant the tooth, this is not always feasible. Recent studies have shown the marked advantages in storing the tooth wrapped in Glad Wrap (Feiglin 1986), or in milk (Blomlof, Lindskog and Hammarstrom 1981), until the tooth can be replanted.

Tap water storage, sometimes recommended, is as detrimental to the periodontal ligament as allowing the tooth to dry out.

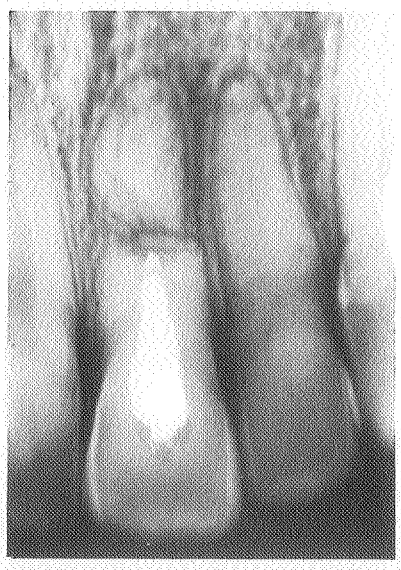

Figure 13. Obliteration of the pulp in the apical portion could not have occurred if the pulp was non-vital.

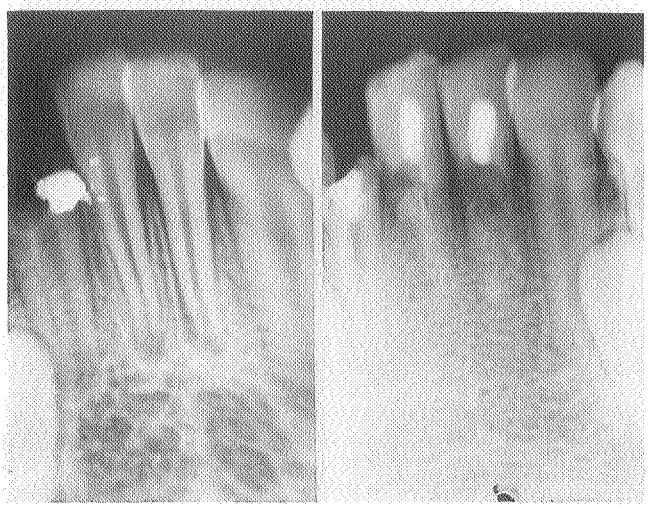

Figure 14. (a) Lower incisor replanted after being out of its socket for 1 and a half hours.

(b) Replacement root resorption is well advanced six months later.

#### (b) Storage time

It has become evident that the sooner the tooth is put back in its socket the less is the chance of replacement (ankylosis) root resorption (Andreasen 1981).

#### (c) Endodontic management

The pulps of avulsed immature teeth that have been replanted rather quickly have the potential to revascularise. Thus under these circumstances the tooth must be carefully observed for evidence of further root growth or the onset of pulp necrosis (Feiglin 1986).

In the case of the mature tooth, endodontic therapy must be commenced within two weeks of replantation to avoid the onset of inflammatory root resorption (Andreasen 1981). Since many sealing agents for root filling are initially cytotoxic they should not be placed in the canal for about three months. Otherwise these sealing agents may extend through the apex and destroy the already compromised periodontal ligament. Calcium hydroxide must be included in this category because of its initial high pH. The root canal should be debrided and then sealed with nothing in it at all for at least three months.

## CONCLUSION

It is apparent that the less the degree of trauma the less the degree of intervention. Naturally the various factors common to all injuries must be looked for and the tooth injuries treated according to their severity. One thing is for certain: trauma involves many of us at one time or another!

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*This paper is based on a series of lectures given to the staff and postgraduate students at the Royal Dental Hospital of Melbourne.*


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