Third Molar Changes Following Second Molar Extractions

John J. Cavanaugh

A clinical and radiographic evaluation of eruption progress of third molars following second molar extractions in 25 cases, finding no impactions, low incidence of fused roots, and general improvement in original angulations.

KEY WORDS: • EXTRACTION • MOLAR, SECOND • MOLAR, THIRD •

In the history of Orthodontics, almost every tooth has been considered for extraction. One obvious exception is the upper central incisor, although we are not sure even that is immune. One of the more controversial extractions at this time is removal of lower second molars in the developing dentition.

Some clinicians are adamantly opposed to removing second molars under any circumstances. At the other extreme, some feel that it is the only way to approach treatment in any case where extractions are indicated.

Fifteen or twenty years ago, contemporary American orthodontists rarely deviated from first bicuspid extractions. Much of the dissension and concern is focused on whether or not the third molar will erupt as a healthy substitute for the electively removed second molar.

That question is the reason for this study.

Mandibular Growth

SICHER (1960) described mandibular growth as a combination of changes in three key areas — cartilaginous growth on the condyle, bone apposition on the posterior border of the ramus, and resorptive remodeling of the anterior border.

Inadequate space for the mandibular third molar may result from a low mandibular growth rate, from vertical direction of condylar growth or from distally-directed eruption of the dentition (BJÖRK ET AL. 1956).

BJÖRK AND SKIELLER (1983) refer to the importance of bi-ramal width in evaluating space for the third molars.

Author Address:
Dr. John J. Cavanaugh
3101 E. Shea Blvd.
Phoenix, AZ 85028

Dr. Cavanaugh is a private practitioner of Orthodontics in Phoenix, Arizona. He is a Dental graduate (D.D.S.) of Georgetown University, and holds a Certificate in Orthodontics from the University of Texas in Houston. He is a Diplomate of the American Board of Orthodontics.

RICKETTS (1979), using his arcial method of growth prediction, felt that space for the lower third molar became available more through mesially-directed eruption of the dentition than remodeling at the anterior border of the ramus. This supports Björk's observation of a relationship between distal direction of eruption and lack of space for the lower third molar.

As early as age 8, the lower third molar crypt can be seen radiographically as a faint circle (SILLING 1973). In the immature mandible, this crypt will still be in the ramus, at or above the juncture with the body, and possibly perpendicular to the body (TAIT 1978).

As the mandible grows and develops, the tilt of the crypt does not change very much for quite some time, with the mesiodistal axis of the third molar crypt remaining essentially parallel to the anterior border of the ramus.

There is usually a harmonious relationship between tooth and mandibular development (SARNAT 1983). The mandible grows whether teeth are developing or not, but the reverse is not necessarily true. The normal eruption of the permanent molars is dependent, at least in part, on normal growth of the mandible.

Sarnat also noted the dependence of alveolar bone on the teeth; if there is no tooth to erupt, there will be no alveolar bone.

The two types of bone cannot be readily distinguished, but the difference in bone level is unmistakeable some time after a tooth has been removed.

This is very important to remember when a second molar has been removed. Viewed radiographically after the extraction, there is a great dark cavern distal to the first molar. As the third molar erupts to take the place of the extracted tooth, it brings its own alveolar bone into place with it, and the bone level returns to normal.

Growth and Development of the Third Molar

ENGSTRÖM ET AL. (1983) describe five stages of development of the third molar. A faint circle may be seen as early as age 8 (SILLING 1973), and as late as 14 (RICHARDSON 1980), with full formation at about age 20 (HELLMAN 1937).

Hellman found that by age 24, 95% of those third molars that would eventually erupt had already done so.

In one of MARGARET RICHARDSON'S works (1980) on the subject of third molars, she found that if there was no radiographic evidence of third molar buds by age 10, there was less than 50% probability that all four teeth would eventually develop.

Whether they developed early or late, the resultant third molars showed no significant difference in size or shape. Third molar buds developing at two, three, or even four different stages were sometimes be seen in the same radiograph.

In an earlier study, DEMISCH AND WARTMANN (1956) had also found great variation in stages of development within the same individual.

FISHMAN (1982) used hand-wrist radiographs, with particular attention to the epiphysis of the radius. He considered mandibular growth complete when this epiphysis closed.

ENGSTRÖM (1983), again using carpal indices, found only the crown of the third molar formed in one third of her subjects at this stage of skeletal maturation. It would seem to follow that one third of Dr. Engström's subjects developed their lower third molars in a non-growing mandible.

SHILLER (1979) reassures us that positional changes in the mandibular third molar are still taking place at age twenty.

Surgical aspects

The report of the symposium sponsored by the NATIONAL INSTITUTES OF HEALTH IN 1979 cautioned that patients

who were to undergo even routine removal of third molars must be apprised of the risks of transitory and perhaps permanent unwanted effects. These include hemorrhage, pain, swelling, alveolar osteitis, trismus and nerve injury.

The unfortunate attitude still seems to be that a malpositioned third molar is *ipso facto* abnormal and subject to sacrifice, even though there was no consensus at the symposium that asymptomatic third molars should be removed.

The English author, Rix (1966) indicated strong feelings about the removal of third molars, especially his! "I would not view with indifference the proposal of having *my* third molars surgically extracted at any age. The sum of misery and expense attached to such third molars tends to be overlooked in the orthodontic world." His reference to "at any age" is well-taken, since the potential risks increase both in number and magnitude with age (Hinds et al. 1980).

Periodontal Considerations

Leaving some mandibular third molars in, or taking them out too late, can result in damage to the periodontal attachment distal to the second molar. Osborne (1982) found that, once the damage was done, the benefit of corrective measures was negligible.

It would seem, therefore, that if such a third molar were removed very early, this problem could be prevented. Clinical research has shown that this is indeed true (NIH 1979).

Ross (1981) in a study of 170 periodontal patients, found that over half of them (54%) had one or more mandibular molars with fused roots. We do not feel that he was saying that they had periodontal problems because they had fused roots. They presented with periodontal problems, and he found an incidence of fused roots. We would expect that radiographic examination of 170 patients in most practices might find a similar situation.

On the other hand, since fused roots have less surface area, periodontal involvement can progress more rapidly.

Incidence of Impaction of Third Molars

It is generally agreed that the mandibular third molar becomes impacted more than any other tooth (Richardson 1975).

From 17% to 25% of the general population will have one or more impacted third molars. The difference may be due to sampling variations, racial characteristics, and/or the clinician's own definition of impaction.

Third molars can and do become impacted, to some degree, no matter how inspired the treatment plan (Fig. 1).

History of Second Molar Extractions

Early references date back to the last century. More recently, Bowdler Henry (1938) presented statistics on 456 cases of impacted third molar removals, some with heinous results. Granted that there was no penicillin at that time, but this was of no concern to those patients who had no post-surgical complications, or to the 38 who died!

In his report Mr. Henry presented his "one minute miracle molar enucleation." Unfortunately, even that seemingly simple procedure was not without its drawbacks, apparently requiring considerably more time to "tidy up" than for the actual surgery.

David Liddle (1977) did not like the faces of some of his orthodontic patients after four bicuspids had been removed. He had been an advocate of third molar enucleation in the early 1940's. Then there was a surgical mishap resulting in a facial paralysis, and he abandoned all thoughts of further third molar enucleation, look-

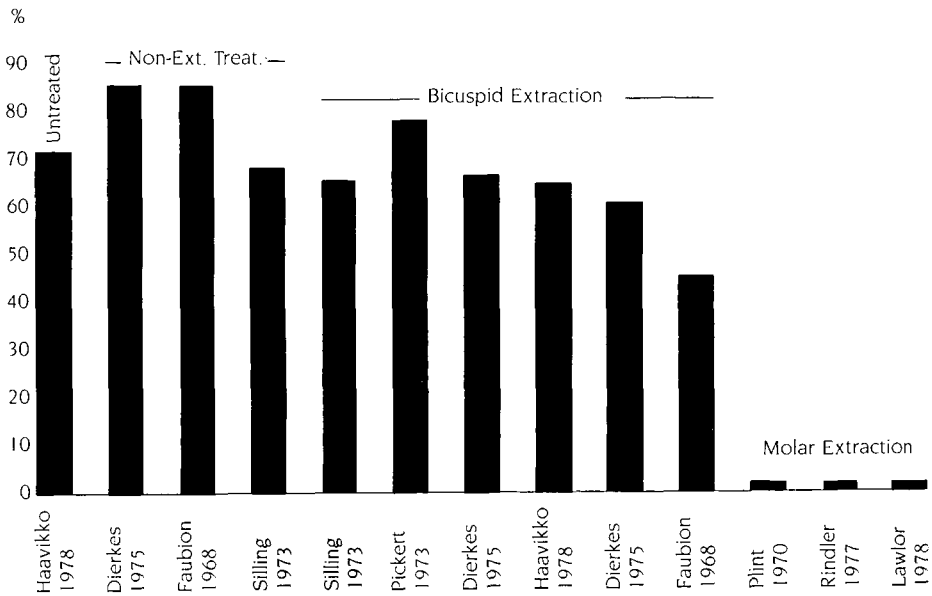


Fig. 1 Incidence of Impacted Third Molars

ing instead to the second molar as a possible means to the same esthetic end. That was in 1942.

WILSON (1974) had also been enucleating third molar buds. He abandoned the practice in the early 1950's, when he came to feel that the procedure subjected the young patient to unnecessary trauma, and began to cautiously advise the removal of second permanent molars.

— Methods and Materials —

A series of progressive panelipse films was obtained for 25 patients for whom all four second molars had been removed. The youngest was operated at age 10½, the oldest at 18½. These subjects were the first 25 to respond to a recall of all second molar extraction cases in a private practice.

Follow-up time ranged from 1yr 10mo to 7yrs.

All but two of these 25 subjects had some type of orthodontic treatment. No third molars were banded or bonded.

In past studies, the methods of assessing the positions and the changes in angulation of lower third molars varied widely. RICHARDSON (1970) took 60° rotated cephalographs and measured the angle between the occlusal surface of the crown and the mandibular plane.

HUGGINS AND MCBRIDE (1978) used 45° rotated cephalographs and measured the occlusal surface of the third molar in relation to the occlusal plane of the other buccal teeth.

Other authors, using different types of radiographs, measured the long axis of the first and/or second molar to the long axis of the third molar (RIX 1966, CRYER 1967).

The method used in this study was based on a reference line constructed between the bifurcations of the lower first molars on the panoramic radiograph.

To test the stability of this line, we consulted with Dr. Charles Morris and technician Felix Cordero at the Radiology Department of the University of Texas at San Antonio. There we x-rayed the 3M Phantom, which is is a human skull with a full natural dentition, encased in transparent plastic with radiographic properties similar to natural tissue. It is designed for teaching correct patient positioning for panelipse films.

Tipping the head 10° left and 10° right resulted in consistent angles of third molars to our line of reference. However, there was *no* congruity in the angles when the head was x-rayed in flexion or extension.

In the molar regions of panelipse radiographs, the angular distortion is ±5° (TRONJE ET AL. 1981). We consider these angles reliable if carefully measured on accurately exposed films.

No cephalographs were used in this study. .

Three separate studies were carried out, for the mandibular first, second and third molars.

The angulation of the occlusal surface of each crown was also measured to the long axis of the tooth and to the long axis of the root.

A periodontist consultant assessed the incidence of fused molar roots on all radiographs. Ross' (1981) interpretation of fused roots was the standard used. No root which was in doubt due to poor radiographic quality or the stage of development was recorded as fused.

— Findings —

The latest panelipse films available for each of the 25 patients in the study group showed all of the 100 third molars erupting. None were impacted.

Changes in angulation ranged from 0° to 49°.

The age of the patients at the removal of the second molars and the age at the latest film varied considerably. The observation period for the youngest patient, a boy in whom third molars were removed at 10½yrs of age, was 4yrs 3mo. For the oldest patient, a girl 18yrs of age at the time of extraction, the post-extraction interval was 5yrs 1mo.

In the boy's case, the angle of the lower right third molar to the bifurcation line was 171° at the time of extraction. It had uprighted to 122° in the latest film.

In the girl's case, the lower right third molar uprighted 37°, from 156° to 119°. The angle between long axis of third to first molar improved from 39° to 1° — almost parallel.

No meaningful correlation was found between the change in lower third molar angulation and elapsed time or age.

Comparing the long axis of the root and the long axis of the tooth to the occlusal surface of the crown on first and third molars, we found that the distal crown/root angle was more acute than the crown/tooth angle.

The root angles were smaller than the tooth angles on both the first and the third molars, and the third molar angles were smaller than the corresponding first molar angles (Fig. 2).

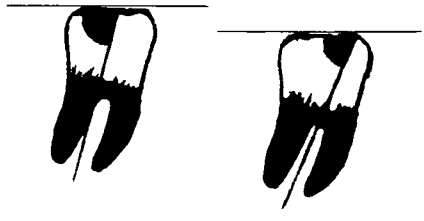
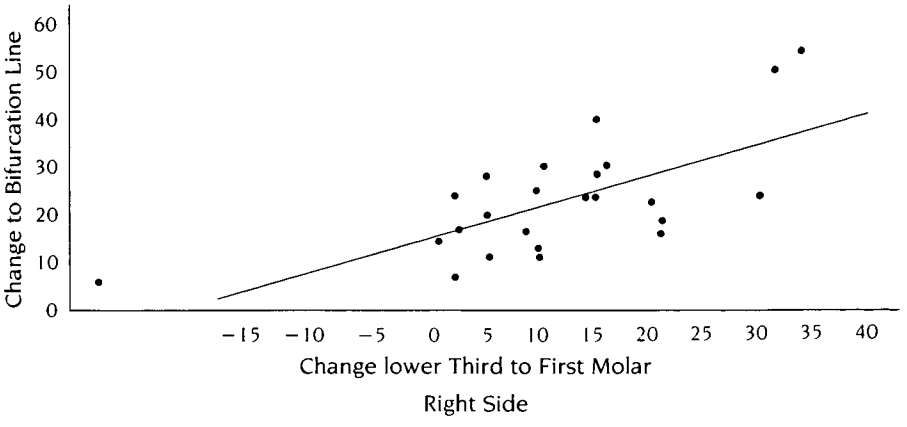


Fig. 2
The long axis of the tooth formed a larger angle with the occlusal surface of the crown (left) than did the long axis of the root (right).



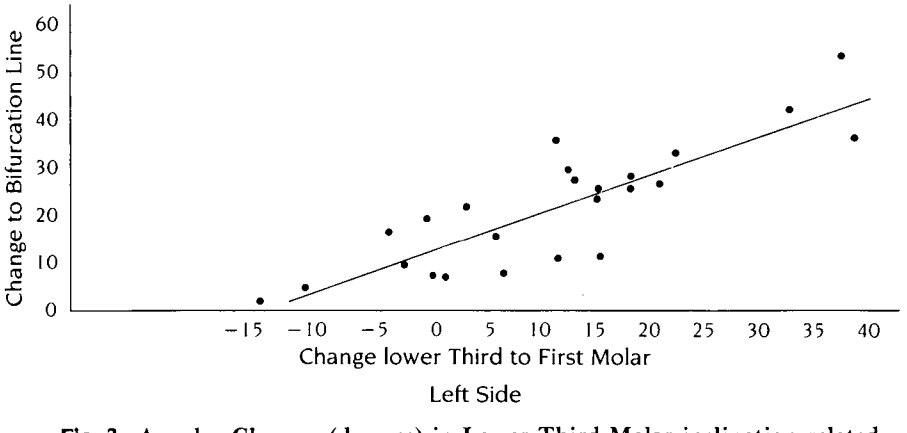


Fig. 3 Angular Changes (degrees) in Lower Third Molar inclination related to First molar axis and to Bifurcation Line.

A positive correlation was found between the change in the angulation of the long axis of the mandibular third molars to the bifurcation line, and the change in their long axis as related to the first molars (Fig. 3).

— Summary and Conclusions —

Third molars, both upper and lower, do usually erupt into the place of electively removed second molars.

None of the third molars in this study group became impacted during the observation period.

Second molars in this study were removed *before* the roots had formed on the third molars.

The bifurcation line appears to be a stable reference on the panoramic radiograph.

It is the Author's conclusion that the extraction of permanent second molars is best for many patients, and when judiciously applied it is a reasonably safe and conservative modality in orthodontic care.

References

Björk, A., Jensen, E., and Palling, M. 1956. Mandibular growth and third molar impaction. *Trans. Eur. Orthod. Soc.*

Björk, A. and Skieller. 1983. *Eur. J. Orthod.* 5:1-46.

Cryer, B. S. 1967. Third molar eruption and the effect of extraction of adjacent teeth. *Trans. British Soc. Study Orthod.* July.

Dachi and Howell. 1961. A survey of 3874 routine full mouth radiographs: A study of impacted teeth. *Oral Surg.* 14:1165-1169.

Demisch and Wartmann. 1956. Calcification of the mandibular third molar and its relation to skeletal and chronological age in children. *Am. J. Orthod.* 27:459-473.

Dierkes, D. D. 1975. An investigation of the mandibular third molars in orthodontic cases. *Angle Orthod.* 45:207-212.

Engström, C., Engström, Helene, and Sagne, Sören. 1983. Lower third molar development in relation to skeletal maturity and chronological age. *Angle Orthod.* 53:97-105.

Faubion, B. H. 1968. Effect of extraction of premolars on eruption of mandibular third molars. *J. Am. Dent. Assoc.* 76:316.

Fishman, L. S. 1982. Radiographic evaluation of skeletal maturation: A clinically oriented method based on hand-wrist films. *Angle Orthod.* 52:88-112.

Graber, T. M. 1981. The mandibular third molar - Its predictive status and role in lower incisor crowding. *Proc. Finn. Dent. Soc.* 77:37-44.

Haavikko, K. 1978. Predicting angulational development and eruption of the lower third molar. *Angle Orthod.* 48:39-48.

Hellman, M. 1937. Some aspects of wisdom teeth and their impaction. *Inst. of Clinical Oral Pathology.* March.

Henry, C. Bowdler. 1938. Prophylactic odontectomy of the developing mandibular third molar: A new operation. *Am. J. Orthod. and Oral Surg.* 24:72-84.

Hinds, E. C. et al. 1980. Hazards of retained third molars in older persons: Report of 15 cases. *J. Am. Dent. Assoc.* 101:246-250.

Huggins, D. G. and McBride, L.J. 1978. The eruption of lower molars following the loss of lower second molars: A longitudinal cephalometric study. *Br. J. Orthod.* 5:13-20.

Lawlor, J. 1978. The effects on the lower third molar of the extraction of the lower second molar. *Br. J. Orthod.* 5:99-103.

Liddle, D. 1977. Second molar extraction in orthodontic treatment. *Am. J. Orthod.* 72:599-616.

National Institutes of Dental Research. 1979. *Removal of third molars.* National Institutes of Health, November. 28-30.

Osborne, W. H. 1982. Attachment levels and crevicular depths at the distal of mandibular second molars following removal of adjacent third molars. *J. Periodontal.* 53:93-95.

Pickert, W. A. 1973. Masters Thesis. University of Tennessee.

Plint, D. A. 1970. The effect on the occlusion of the loss of one or more first permanent molars. *Trans. Eur. Orthod. Soc.*

Richardson, M. E.

1970 The early developmental position of the lower third molar relative to certain jaw dimensions. *Angle Orthod.* 40:226-230.

1975 The development of third molar impaction. *Br. J. Orthod.* 2:231-234.

1980 Late third molar genesis: Its significance in orthodontic treatment. *Angle Orthod.* 50:121-128.

Ricketts, R. M. 1979. Studies leading to the practice of abortion of lower third molars. *Dent. Clin. North Am.* 23:393-411.

Rindler, A. 1977. Second permanent molar extractions in Class II cases with crowding in the lower arch. *Swed. Dent. J.* 63:699-708.

Rix, R. E. 1966. Further thoughts on monobloc therapy. *Trans. Br. Soc. Orthod.*

Ross, I. F. 1981. Root fusion in molars: Incidence and sex linkage. *J. Periodontol.* 52:663-667.

Sarnat, B. G. 1983. Normal and abnormal craniofacial growth: Some experimental and clinical observations. *Angle Orthod.* 53:263-289.

Shiller, W. R. 1979. Positional changes in mesioangular impacted mandibular third molars during a year. *J. Am. Dent. Assoc.* 99:460-464.

Sicher, H. 1960. *Oral anatomy.* 3rd ed. St. Louis:C.V. Mosby.

Silling, G. 1973. Development and eruption of the mandibular third molar and its response to orthodontic therapy. *Angle Orthod.* 43:271-278.

Tait, R. V. 1978. Factors influencing primary inclination of lower third molar crypts. *Br. J. Orthod.* 5:41-45.

Tronje, G., Welander U., McDavid, W.D. and Morris, C.R. 1981. Image distortion in rotational panoramic radiography in clinical objects. *Acta Radiologica Diagnosis* Fasc. 5.

Wilson, H. E. 1974. Long term observation on the extraction of second permanent molars. *Trans. Eur. Orthod. Soc.*

The Author thanks Dr. Merle Bean for the radiographs, Dr. Steve Reitan for his evaluation of fused roots, and William and Ute Matthes-Sears for their statistical work.

Suzette Liddle deserves special recognition. In the midst of the trauma related to her father's death, Suzette still managed to locate former patients for follow-up radiographs.