

Lower dental arch changes after bilateral third molar removal

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SUMMARY

Objective. To evaluate the changes in lower dental arch after bilateral lower third molars removal.

Material and methods. The study group consisted of 30 non-orthodontic patients (mean age 25,5 years, referred for bilateral lower third molars removal. Orthopantomograms and dental casts were made before and 6–8 months after surgical removal of lower third molars. Transversal lower arch widths between lower canines and second premolars and lower arch total tooth size–arch length discrepancy were evaluated on dental casts. The angulation of lower second premolars, first and second molars was measured in horizontal and mandibular planes on orthopantomograms.

Results. No significant difference of inter-canine and inter-premolar transversal width was noticed. No significant changes were observed in total tooth-size length discrepancy, except in S1 segment consisted of first and second premolar and the canine on the right quadrant of the lower dental arch. The angulation of second premolars and first molars did not show any significant changes, however there were statistically significant changes between angulation of lower second molars on both sides.

Conclusions. After bilateral removal of lower third molars, lower second molars awhile showed a tendency to move backwards, but no obvious relationship between the third molar and anterior crowding was observed. Whereas the observation time is short and the patient's age is young and it can not be concluded that lower third molars cause the changes in the dental arch.

Key words: lower dental arch crowding, lower third molars surgical removal.

INTRODUCTION

The effect of lower third molars (LM3) impaction on dental arch changes has been investigated for over the century. Impaction of the LM3 is a high incident problem occurring in up to 73% of young adults in Europe (1). Widespread opinion that late lower arch crowding is mostly affected by LM3 because these teeth exert pressure from the back of the arch. However the necessity of LM3 removal is questionable.

Not everyone impacted tooth is associated with clinically severe symptoms. Already in 1979 the

American National Institute of Health established indications of LM3 removal: recurrent pericoronitis, untreated caries, cysts, periodontal disease and the resorption of adjacent tooth root (2). There are some situations when the removal of LM3 is contraindicated because surgical complications and consequences outweigh the benefits (3). Contraindications are evaluated according to the patient physical condition and general diseases. The patient's age is one of the most common relative contraindication (3). Oral surgeons recommend the removal of the LM3 by the age of 20 because in older patients jaw bone is more calcified and less elastic, so more bone tissue has to be removed during surgery (4).

In fact, because of its high prevalence, late mandibular incisor crowding is considered a normal part of the aging process: maxillary and mandibular arch lengths increases at 8 and 13 years (5). Later there is significant and consistent reduction in both arches length mesial to the permanent first molars. This reduction continues until age 45 (5).

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Unfortunately, the risk of late incisor crowding is unpredictable on an individual basis. It appears to be associated with all classes of malocclusion. The etiology undoubtedly is multi-factorial. Leading theories can be grouped into two categories: those proposing that the problem is lingual movement of anterior teeth and those suggesting that the problem is caused by forward movement of posterior teeth.

The authors who confirm that anterior teeth are moving back maintain the theory that a stable dentition exists in a state of balance – where the pressure of the tongue, lips, cheeks and periodontium is zero. If this balance is disturbed, the teeth will move until a new state of equilibrium is reached. Little *et al.* analyzed data from non orthodontic patients, and concluded that incisor crowding became more severe in adolescents, young adults or even later in life with no obvious cause (6). Many authors tried to find out those reasons: Siatkowski claimed that lower incisors might move under the forces of tongue and lip muscle contraction, Halvold focused on the effect of soft tissue pressure and reported that the volume and position of the tongue is related to lower dental crowding (7, 8). Moss and Picton reported that lower tooth inclination is influenced by cheek pressure (9).

The other group of authors propose that erupting LM3 push lower posterior teeth forward and causes crowding of the incisors. Series of authors in their studies confirmed this: Vego and Richardson stated that the erupting LM3 exert pressure from the back of the arch (10, 11). In a longitudinal investigation Richardson pointed out that anterior movement of the erupted first molars is important for the late lower arch crowding (12). Schwarze found that the average subsequent mesial movement of the first molars was 1,5 mm greater in the 49 patients with retained LM3 than in the 100 who underwent early LM3 germectomy (13). Richardson and Mills reported that lower second molar extraction reduces the tendency to forward movement of buccal segments and increased crowding by relieving eruptive pressure from LM3 (14).

The aims of the present study were therefore:

- to find transversal lower arch width changes between lower canines and second premolars;
- to evaluate total tooth size – arch length discrepancy (TSALD) changes;
- to ascertain the inclination changes of lower second premolars, first and second molars after bilateral LM3 removal.

MATERIALS AND METHODS

Before starting the study, the approval was taken from the bioethical committee of Lithuanian Univer-

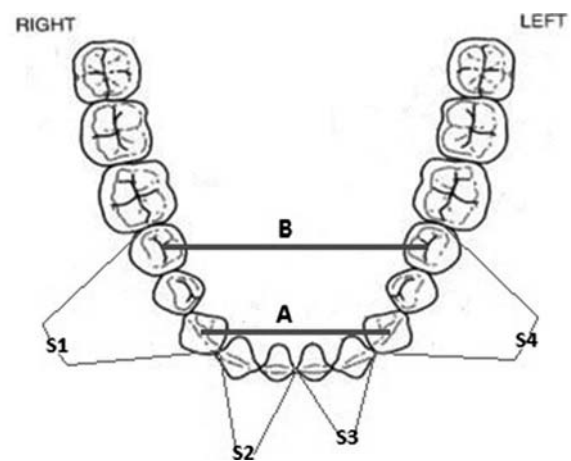


Fig. 1. Measurements of the dental arch. TSALD: S1 arch segment: first and second premolar and the canine on the right quadrant; S2 arch segment: first and second incisors on the right quadrant; S3 arch segment: first and second incisors on the left quadrant; S4 arch segment: first and second premolar and the canine on the left quadrant. Width: A – distance between the canine cusps, B – distance between the second premolars measured in the middle of the intercuspal fissure.

sity of Health Science. The study group consisted of 30 patients from the Oral and Maxillofacial Surgery Department, who were referred for bilateral LM3 removal. Patients age ranged between 16.2 and 55.1 years, with the mean age with 25.5 years. The study consisted of the dental casts and orthopantomograms of 30 (62.96% female and 37.04% male) patients before and after (6–8 months period) surgical LM3 removal.

The criteria for inclusion to the study:

- complete lower dental arch;
- age at least 16 years;
- no orthodontic treatment before records collected;
- bilateral LM3 removal;
- good quality orthopantomograms and plaster casts.

The most frequent reasons for referral were problems related with LM3 eruption and pain in 12 cases (44.44 %), other reasons were recommendations of orthodontist in 11 cases (37.03 %) and patients initiative in 7 cases (22.22 %).

Orthopantomograms (OPG) and dental casts were

Table 1. The width of lower dental arch between the lower canines and second premolars before and after surgical LM3 removal

	N	Arch width (average) between lower			
		Canines		Second premolars	
		Width	SD	Width	SD
Before LM3 removal (mm)	30	26.31	2.88	35.29	2.69
After LM3 removal (mm)	30	26.37	2.85	35.08	2.74
Change (+/-)	30	+ 0.06		+ 0.21	

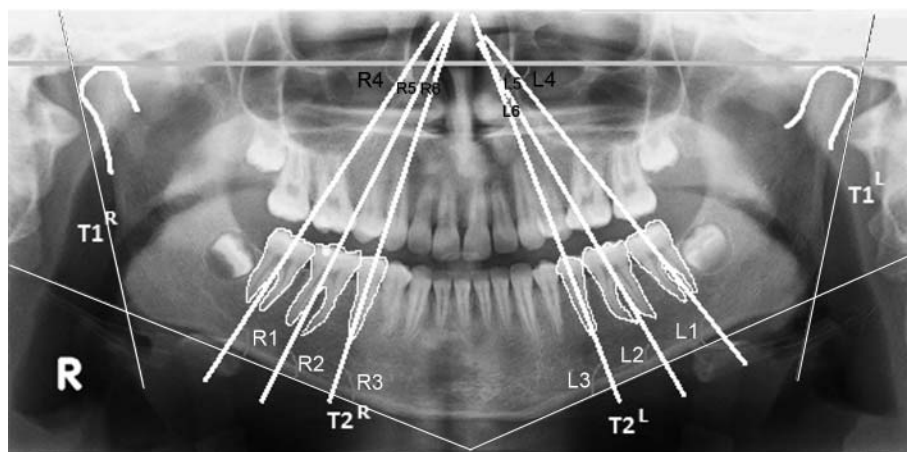


Fig. 2. Predental consultation source of advice on the toothache among the respondents. R1 – Ax 47/T2^R on the right side; R2 – Ax 46/T2^R on the right side; R3 – Ax 45/T2^R on the right side; R4 – Ax 47/HL on the right side; R5 – Ax 46/HL on the right side; R6 – Ax 45/HL on the right side; L1 – Ax 37/T2^L on the left side; L2 – Ax 36/T2^L on the left side; L3 – Ax 35/T2^L on the left side; L4 – Ax 37/HL on the left side; L5 – Ax 36/HL on the left side; L6 – Ax 35/HL on the left side.

made before and after LM3 removal of 30 patients. All radiographs were traced by hand on matte acetate sheets and measured by a single investigator (RS). All the measurements were performed twice with two weeks interval to evaluate intra-examiner variability. The angulation of the both side lower second premolars, first and second molars was evaluated in the OPG (16). These records were repeated at the end of the observation period. The models were used for measurement of space analysis (TSALD) and lower dental arch width changes.

Analysis of the plaster casts

The mandibular dental arch was examined on the plaster casts using metal gauge with a 1/10 mm scale and with tips sharpened to a point. Dental arch widths, lengths and teeth size measurements were obtained on the mandibular dental casts before and after observation period. The measurements included:

Total tooth size-arch length discrepancy (TSALD).

The lower dental arch was divided in to 4 segments (Fig. 1) and TSALD was calculated for every separate segment (17):

$$S1 = \boxed{45-43 \text{ teeth arch length}} - \boxed{43-44-45 \text{ teeth crown width}} = \text{TSALD}$$

Table 2. Reason that prompted the decision to seek dental treatment for toothache among the respondents

	N	Lower arch segments							
		S1	SD	S2	SD	S3	SD	S4	SD
Before LM3 removal (mm)	30	2.69	1.73	1.82	1.04	1.77	1.42	2.63	1.78
After LM3 removal (mm)	30	2.35	1.72	1.71	1.47	1.70	1.13	2.43	1.78
Total	30	reduction 0.34 mm*		reduction 0.11 mm		reduction 0.07 mm		reduction 0.20 mm	

* (p<0.05).

All the parameters were measured using callipers with the pinpoint placed parallel to the occlusal surface of the dental arch segment.

Dental arch transversal width between lower canines and second premolars was also assessed (Fig. 1) (18).

Radiographic analysis: Panoramiometry

Descriptions for the different lines and planes are present and they are used for the left or right side, respectively according to Puricelli recommendations (19) (Fig. 2):

Horizontal line (HL) – joining the most superior point of the both condyles.

T1^R, T1^L – these lines can be traced through the most dorsal points on the posterior surface of the condyle and ramus (on the right and left sides).

T2^R, T2^L – these lines can be traced through the borders of the most inferior outline of the body and the region of the mandibular angle.

Ax – long axes of lower second molars (Ax 47; Ax 37) and first molars (Ax 46; Ax 36) were traced from the midocclusal point through the midpoint of the root bifurcations (20). The long axis of the lower second premolars (Ax 45; Ax 35) were traced from the midocclusal point through the midpoint of the root.

Statistical analysis

Descriptive statistics included the mean, standard deviation, minimum and maximum values for each parameter and their changes between observation periods.

Paired *t*-tests were used to determine the level of statistically significant differences within each parameter between each observation period.

RESULTS

Changes of the width in the lower dental arch.

Although the inter-canine width after LM3 removal increased 0.06 mm and inter-premolar width increased 0.23 mm, no significant difference in the changes of inter-canine and inter-premolar transversal width was observed ($p>0.05$). All the data present in Table 1.

TSALD changes in the four segments of the lower arch.

The changes were slightly higher in segments S1 and S4 between posterior teeth. There was significant difference before and after LM3 surgical removal measurements only in S1 segment ($p<0.05$). All the data present in Table 2.

Changes of the lower teeth angulation

The bilateral extraction of LM3 seemed to result in changes of lower second premolars, first and second molars angulation. The angulation of the teeth was measured in two planes: horizontal (HL) and mandibular (T2) before and after LM3 removal. The angulation of second premolars and first molars on both sides (right/left) did not show any significant changes on HL or T2 ($p>0.05$). There were statistically significant changes between angulation of lower second molars (right; left) – HL and T2 ($p<0.05$). The greatest change (3.02 degree) has been observed in lower second molar angulation (right side) and T2^R

and it was statistically significant. All the data present in Tables 3 and 4.

DISCUSSION

The purpose of this study was to evaluate lower dental arch changes and inclination of lower teeth in the lateral segments before and after bilateral LM3 removal.

We found that the most frequent reasons for LM3 removal were problems related to these teeth eruption and pain (44.44%), orthodontic indications (37.03%) and patients initiative (22.22%). These findings coincide with Niedzielska results, where 51% of patients had problems with LM3 eruption and 34% patients had orthodontist recommendations (18).

Results of our study showed no significant difference in the inter-canine and inter-premolar transversal width before and after LM3 removal ($p>0.05$). Haradine *et al.* also found no statistically significant difference in the transversal width between lower canines before and after LM3 removal (21). Also, our results confirm Bishara *et al.* findings who measured lower dental arch transversal width changes between first premolars and first molars before and after LM3 removal (1). The author concluded that arch width changed little and there were no significant differences between measurements (1). Niedzielska published that bilateral extraction of LM3 seemed to result in an increase in width between lower canines, second premolars and second molars from +0.45 to +1.05 (18). The results of

Table 3. Panorametry measurements on the right side of the lower dental arch before and after LM3 removal

	The panorametry measurements on the right side of the lower dental arch											
	47/HL	SD	47/T2 ^R	SD	46/HL	SD	46/T2 ^R	SD	45/HL	SD	45/T2 ^R	SD
Before LM3 removal	67.87°	12.78	83.00°	11.97	67.63°	5.78	85.61°	6.54	66.70°	5.43	83.78°	8.14
After LM3 removal	65.18°	13.22	86.02°	12.15	66.26°	6.40	86.81°	4.93	66.15°	5.90	84.25°	7.45
Change	2.69°*		3.02°*		1.37°		1.20°		0.55°		0.47°	

* ($p<0.05$).

Table 4. Panorametry measurements on the left side of the lower dental arch before and after LM3 removal

	The panorametry measurements on the left side of the lower dental arch											
	37/HL	SD	37/T2L	SD	36/HL	SD	36/T2L	SD	35/HL	SD	35/T2L	SD
Before LM3 removal	67.87°	12.78	80.66°	9.53	64.93°	5.05	84.61°	4.94	64.56°	5.40	84.00°	7.49
After LM3 removal	65.25°	13.22	83.00°	11.97	63.46°	6.40	86.06°	6.55	64.34°	5.80	84.20°	7.05
Change	2.62°*		2.34°*		1.47°		1.45°		0.22°		0.20°	

* ($p<0.05$).

Niedzielska was significantly higher than those previously listed authors, because the patients observation period was significantly longer (18).

Our results indicate that crowding does not change in none of the dental segments after LM3 removal. However, crowding was statistically significant reduced only in S1 segment ($p < 0.05$). As a result, we accept with Hasegawa *et al.* conclusions, that LM3 influences only the lateral segments and there is no relationship between the LM3 and anterior crowding (22). Niedzielska also measured lower dental arch segments before and after LM3 removal and concluded that crowding was more frequently decreased on the side where the LM3 was absent after three years period (18).

We try to evaluate changes in the lower dental arches not only by the plaster casts but also by the radiographic analysis. The bilateral extraction of LM3 seemed to result in statistically significant changes of lower second molars angulation in two planes: HL and T2. The greatest change has been observed in lower second molar angulation (right side) and T2^R. The angulation of second premolars and first molars on both sides (right; left) did not show any significant changes ($p > 0.05$). Jain *et al.* took only the horizontal plane as a reference to evaluate LM3 and second molar angulation (24). The results of the second molar angulation difference between the measurements was $\sim 5.7^\circ$ because the study observation period was longer (24).

Most of previous studies in the twentieth century (Bergstrom and Jensen (1961), Vego (1962), Schwarze (1973), Lindqvist's (1982), Richardson (1989)) suggested that LM3 have a large influence on dental crowding and these teeth cause pressure from the back of the arch (11, 25-28). However, recent studies indicate the contrary: LM3 did not exert any significant influence on the length and width of the dental arches and did not contribute to incisor crowding (Harradine

et al. (1998), Sidlauskas *et al.* (2006), Shigenobu *et al.* (2007), Lakhani *et al.* (2011), Ahmed *et al.* (2011), Hasegawa *et al.* (2013) and etc.) (20-22, 29-31). Also LM3 cause little or no influence in the mesiodistal angular positioning of the teeth in lateral segment (Rodrigo Castellazzi Sella (2009), Okazaki (2010), Coughi *et al.* (2010), Hasegawa *et al.* (2013)) (22, 32-33, 37).

However, over the time, for some reasons dental crowding is increasing. Bishara *et al.* indicated that there is an increase in the TSALD with age (1). Similar findings have been observed on untreated normal subjects by Lundstrom and Sinclair and Little (34, 35). It was found that in the absence of the LM3, the dentition has space to settle distally under anterior pressures caused by late growth or soft-tissue changes but after a longer observation time dental crowding continues to increase again (23). Supposedly, many factors may influence development and changes in the anterior alignment with age. Factors may include: occlusal force, dental wear, anterior component of force by functional vectors, changing facial morphology and growth of anatomical structures, the forces of tongue and lip muscle contraction, the volume and position of the tongue and soft tissue, cheek pressure (7-9, 30, 33, 36). All these effects increase with age – getting stronger and causing unwanted changes in the teeth position.

CONCLUSIONS

Therefore, based on the present study data it could be concluded that, after bilateral LM3 removal lower second molars showed a tendency to move backwards. However, we can't argue that bilateral LM3 removal reduces dental crowding and further investigations are needed to determine more reasons or predictors of teeth crowding.

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