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Cephalometric evaluation of the craniofacial complex in patients treated with an intraoral distraction osteogenesis device:

A long-term study

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Abstract

Introduction—Distraction osteogenesis has gained popularity because of the hypothesized concurrent soft-tissue expansion, which is believed to reduce postoperative relapse. Although many articles describe the immediate success of mandibular distraction, little research has been done on its long-term stability. Our goal was to examine the long-term craniofacial changes after distraction.

Methods—Four hemifacial microsome patients treated with unilateral mandibular distraction were recalled. Changes in maxillary width and height, occlusal height, ramus height, mandibular length, and chin position were quantified by using the posteroanterior and 45° lateral oblique cephalographs. Predistraction and postdistraction measurements were taken over a 5-year period. The data were analyzed by using paired *t* tests and ANOVA.

Results—Maxillary height, ramus height, mandibular length, and chin point deviation all experienced moderate improvement after distraction. Although the growth patterns between the control side and the treated side were comparable until 2 years after removal of the device, the normal side outgrew the affected side thereafter until 5 years after distraction.

Conclusions—Because of the greater inherent growth potential of the unaffected side, more overcorrection than originally believed is needed to offset the persistent asymmetry in growing hemifacial microsomia patients who undergo unilateral distraction osteogenesis.

Hemifacial microsomia (HFM) is a condition in which the lower half of 1 side of the face is underdeveloped. It occurs in from 1 in 35001 to 1 in 56002 people and is the second most

common facial birth defect after clefts. HFM always involves mandible and ear malformations, but severity varies. To overcome the facial asymmetry, mandibular distraction osteogenesis (DOG) is often performed. This procedure was first described in 1905 to correct limb length discrepancies and later applied to the mandible in 1992.³ Because new bone is generated at the distraction Unlike jaw advancement surgery, the soft tissues (skin, fat, vessels, nerves, and muscles) are stretched gradually during DOG and are hypothesized to expand with the bony enhancement. This global expansion is believed to eliminate the soft-tissue recoil of traditional surgical techniques, thus reducing postoperative relapse.⁵ Compared with the conventional autogenous bone-grafting procedure, with potential side effects such as donor site morbidity and greater susceptibility to relapse, DOG appears to be a more appealing treatment option that has gained popularity over the years.⁸⁻⁹

Although the advantages of DOG are obvious, few attempts have been made to evaluate the long-term changes in jaw length and amount of relapse.¹⁰ In a pilot study, Trahar et al.¹¹ examined the efficacy of an intraoral DOG device in treating patients with HFM. They concluded that the intraoral distractor can lengthen the hypoplastic mandible and that the distracted side grows at a similar rate to the normal side.¹¹ However, this study had a short follow-up period of 2 years, and most subjects had not completed or even entered their growth spurt at the follow-up.¹²⁻¹⁶ Because mandibular growth concludes at a later age, this makes relapse interpretation difficult. To better examine stability, the goal of this long-term evaluation was to assess patients at 5 years postdistraction when the growth spurt was reached.

MATERIAL AND METHODS

Four of the 6 patients from the pilot study were recalled (Table I). One patient refused to participate in further studies, and the other could not be reached. The subjects were diagnosed with HFM and recruited from the Craniofacial Clinic at the University of California at Los Angeles; all underwent unilateral mandibular distraction as described by Trahar et al.¹¹

The pilot study followed all 6 patients to 1 year after distraction and 4 patients to 2 years after distraction, whereas this long-term study followed the remaining 4 patients to 5 years after distraction. Three patients had complete records at every interval, but 1 had records for only T1 (preoperative), T3 (device removal), T5 (16 months postremoval), and T6 (112 months postremoval). Table II outlines the specific radiographs prescribed for each of the 8 intervals. Like the original research, a full set of radiographs included panoramic, submentovertex, lateral and posteroanterior (PA) cephalographs, right and left 45° lateral oblique cephalographs (LOCs), and right and left tomograms. For both the pilot study and this one, only the PA and the 45° LOCs were used for data analysis. The same landmarks, reference planes, and measurements (mandibular length, chin point deviation, maxillary height, maxillary width, occlusal height, and ramus height) from the original study were used.¹¹

Radiographs from T1 to T7 were hand traced by the same investigator (M.T.) in the pilot study. Radiographs for T8 were hand traced by another investigator (A.C.). Each measurement was repeated 3 times, and the mean was recorded for data comparison. Similar to the pilot study, the reproducibility of measurement was determined by Dahlberg's double determination method.¹⁷ Measurements were made at least 1 week apart on 10 radiographs. The equation $S_x = \sqrt{\sum D^2 / 2N}$ (D , difference between duplicate measurements; N , number of double measurements) was used to compute the error of the method.

The differences between the treatment and control means were calculated as treatment minus control. Because we followed 4 of the 6 patients from the original study, the results from T1 through T7 were recalculated by using information from only those 4 patients to keep the sample consistent.

Paired *t* tests were used to examine the difference between the treatment and control sides for each patient, and for each measurement at a specific time point. Analysis of variance (ANOVA) was used to distinguish whether a mean difference at a particular interval was significantly different from all others. If an ANOVA value was significant, a post-hoc *t* test was conducted to detect the mean differences between specific intervals by pairwise comparison ($P = 0.05$).

RESULTS

The changes for each variable with the associated standard deviations are shown in Figures 1 through 5. Similar to the pilot study, treatment represents the side that underwent distraction, whereas control is the unaffected side.

Maxillary height (linear distance measured from horizontal plane to J point; the horizontal plane is defined by the line connecting the right lateral margin of the zygomaticofrontal suture to the left lateral margin of the zygomaticofrontal suture; J point is defined as the maximum concavity on the contour of the maxilla between the lower contour of malar bone and the maxillary first molar) for the distracted side increased 5.1 mm from T1 to T8 compared with 6.5 mm for the normal side. There were significant differences between the treatment and control sides at all time points. The mean difference at T8 was the greatest (7.23 mm), suggesting that either the normal side outgrew the distracted side or relapse occurred. ANOVA shows that the discrepancy between the treated and untreated sides did not differ among the intervals ($P = 0.1102$). However, pairwise comparison showed significant variations between T4 and T5, T4 and T6, and T4 and T8 (Table III), implying reduction in the treatment-control difference at T4.

Overall, maxillary width (linear distance measured from the vertical plane to J point; the vertical plane is defined as the line perpendicular to the horizontal plane through crista galli) for the distracted side increased 1.5 mm compared with 1.1 mm for the normal side. The treatment-control differences for maxillary width were not significant at any interval. In addition, ANOVA showed that the treatment-control differences were similar among the various intervals ($P = 0.9848$), and pairwise comparisons indicated no differences between these times. However, this might be due to the large standard deviations (Fig 1), indicating that the sample size was too small to detect significances.

The treatment-control difference for occlusal height (linear distance from horizontal plane to contact point of the maxillary and mandibular first molars) was statistically significant at all intervals except T7 ($P = 0.0734$). The discrepancy at T8 (-6.05 mm) was similar to that at T1 (-6.68 mm), showing little long-term improvement. However, the minimal treatment-control difference at T7 (-4.53 mm) implied short-term improvement from distraction. When examining trends, we were not surprised to find the occlusal height graph (Fig 2) mimicking the ramal height graph (Fig 3). This occlusal height change on the affected side was mainly a dentoalveolar compensation for an interocclusal space created by unilateral mandibular distraction.

Overall, ramus height (linear distance from antegonial notch to horizontal plane) increased 7 mm on the distracted side vs 12 mm on the normal side. There were significant discrepancies between the treatment and the control. This difference was the smallest at T5 (-12.60 mm) but escalated gradually until T8 (-18.85 mm). This demonstrated that the

distracted side was approaching the normal side at T5 but increasingly fell behind until T8. The initial difference at T1 was -13.80 mm, whereas the final difference was -18.85 mm.

The total increases in mandibular length (linear distance from condylion to symphysis) were 14.7 mm for the distracted side and 15.6 mm for the normal side. The differences between treatment and control were significant at all intervals. Nevertheless, ANOVA indicated that the differences are not significant over time ($P = 0.529$). Both the distracted and normal sides showed a comparable upward trend (Fig 4). The treatment control-differences were smaller at T2, T4, and T7. This can be explained by the fact that the patient with the shortest mandibular length did not participate in those periods.

Initial chin point deviation (linear distance from menton to vertical plane) was -9.4 mm at T1, and the final deviation was -12.8 mm at 5 years postdistraction. The treatment-control difference was significant at all periods, but ANOVA did not show any 1 time to be significantly different from the others. Similarly, the pairwise comparisons showed no significance. According to Figure 5, menton fluctuated toward and away from the skeletal midline from T1 through T7. It appeared to approach the midline at T2, T4, and T7, implying improvements at those periods. However, the reason that the chin point deviation appears less at those intervals might be because of 1 subject's nonparticipation during those times. Overall, this patient had greater asymmetry than did the others (Fig 6).

DISCUSSION

Similar to the pilot study, the craniofacial changes after DOG were quantified by using the PA and 45° LOCs. As previously mentioned by Trahar et al,¹¹ landmark identification can be difficult because of size or shape distortion,¹⁸ superimposition of structures,¹⁹ and variability in patient anatomy. Additionally, magnification errors can cause problems in measurement reliability. To reduce these imprecisions and examine mandibular length with greater accuracy, the 45° LOCs were used in this study because they were oriented more parallel to the lower border of the mandible.²⁰ Furthermore, by using both the right and left LOCs, superimposition of the structures from the contralateral side was minimized, and visualization of 1 side of the mandible was enhanced.²¹ Barber et al²² found that measurements from LOCs varied by 0.3 mm or less when compared with direct skull measurements. As for measurement reliability, Hatton and Grainger²³ determined the magnification to be less than 10% and tracing errors to be negligible. Therefore, by using the right and left LOCs, we expected fewer superimposition and magnification differences of the 2 sides. The reproducibility of the radiographs was also critical. Head positioning is especially important for the 45° LOCs. To ensure standardization, all radiographs were taken at our Department of Radiology by 1 of 2 trained technicians using the same machines.

Throughout our study, mandibular length increased for both the distracted and the normal sides. The distracted side increased by 14.7 mm compared with 15.6 mm on the control side, implying that the intraoral distraction device we used is moderately effective for lengthening the mandible. However, immediately after expansion (T2), the mean mandibular length on the treated side had a 3.9 mm decrease with essentially no change on the control side. As previously mentioned by Trahar et al,¹¹ this early reduction in mean mandibular length was most likely due to clinical relapse after DOG. Despite this, both the treated and untreated sides showed similar upward trends (Fig 4). Just like the pilot study, mandibular growth on the distracted side kept up with the control side until 2 years postdistraction (T7). This result agrees with the results of Tehrani and Behnia.²³ Their evaluation of 10 patients who underwent unilateral DOG showed that improvements in asymmetry were seen after 25.5 months.²⁴ Likewise, another study by Rachmeil et al⁶ demonstrated improvement in facial

symmetry 1 year later, and the distracted side continued to grow at a similar rate relative to the unaffected side. However, such results appear to be short term. When we examined the asymmetry in the long term, the normal side had a 7.2 mm average increase in length from 2 to 5 years after distraction compared with the affected side with an average increase of only 0.8 mm. Growth velocities can be inferred from the slopes derived from graph 4. From 2 to 5 years postdistraction, the control side had a steeper slope, thus implying a greater growth rate than that of the distracted side. Molina and Monasterio,⁵ who evaluated 18 patients with HFM for 3 to 42 months after DOG, also discovered that the distracted side grew less than the unaffected side. Likewise, Hollier et al¹⁵ demonstrated a gradual return to the original asymmetry in a younger (under 4 years of age) sample after 12 to 92 months of follow-up because of a slower growth rate on the affected side. Our research and other studies indicate that a greater overcorrection than originally thought necessary might be required to minimize the persistent asymmetry in chin point deviation and mandibular length in a growing patient with HFM in addition to the expected relapse. The amount of overcorrection needs to be determined by enrolling more subjects with a control sample matched for age and severity.

When deciding whether to recommend DOG, one must determine whether the subjects would exhibit more asymmetry without treatment. It would be informative to compare our study sample with subjects matched for initial asymmetry who declined distraction. Before treating patients with DOG, it is important to estimate the amount of advancement needed while considering relapse. In patients with HFM, the ratios of predicted bony movement from the radiographs to the actual distraction distance are 1:1 in the vertical dimension and 1:2 in the AP dimension.²⁵ Thus, the required distraction distance is twice the predicted length in the sagittal plane. This can be explained by the rotation of the mandible around the unaffected side during unilateral distraction.

In our study, menton seemed to approach the midline at the end of expansion (T2), at 3 months postremoval (T4), and at 24 months postremoval (T7), implying improvements at these times. However, this impression of chin point improvement might not be completely valid because our subject with the greatest asymmetry did not participate during these intervals. Nevertheless, when looking at each subject separately, 2 patients showed less chin deviation than the initial divergence from the skeletal midline until 1 year after removal of the device (Fig 6). To maintain long-term improvement in facial symmetry, mandibular growth on the distracted side would have to be greater than that of the normal side. In our evaluation, final chin deviation at 5 years was -12.8 mm compared with the initial -9.4 mm. Three subjects had greater fluctuations from the midline from 24 months to 60 months postdistraction (Fig 6). This return of skeletal asymmetry is also shown in the clinical photographs in Figure 7. This finding is probably due to the relatively lesser inherent growth potential on the affected side. As mentioned before, the chin point was never fully corrected to be coincident with the skeletal midline. To compensate for the late completion of mandibular growth on the control side together with less growth potential on the affected side, more midline overcorrection might be necessary.^{15,24} In spite of efforts to achieve facial symmetry, it is not always possible to fully correct and maintain chin position coincident to the facial midline. To improve the final esthetics for these patients, a sliding genioplasty or an extrasurgical procedure, such as a free dermis fat graft could be performed.²⁵

For occlusal height, the increase at the end of expansion (T2) was greater for the distracted side than the control side (Fig 2). This is mostly due to dentoalveolar compensation as the maxillary teeth erupt into the open-bite space created by the downward displacement of the mandible immediately after distraction. Rubio-Bueno et al²⁶ also found a similar posterior open bite on the lengthened side. Again, for these patients, the posterior open bite

disappeared as a result of dentoalveolar growth.²⁶ When looking at occlusal height changes after expansion (T2), we found that it increased at similar rates bilaterally, perhaps depicting the vertical facial growth pattern. Since dentoalveolar effects are not skeletal, they are not inhibited in patients with HFM. Therefore, relatively equal vertical growth rates were expected bilaterally. This notion was also supported by our finding of similar occlusal height increases for the treated (10.8 mm) and untreated (10.1 mm) sides.

For maxillary height, the affected side had an immediate enhancement after distraction, whereas the control side had a slight decrease. This initial increase was probably due to dentoalveolar changes. From around the end of expansion (T3) to 2 years after device removal (T7), comparable patterns were seen, depicting normal facial growth on both sides. The large difference (-7.23 mm) between the treatment and the control at 5 years postdistraction (T8) hints that the normal side outgrew the distracted side. It was hypothesized that, in patients with HFM, if mandibular correction is achieved before the growth spurt, then the secondary maxillary deficiency can perhaps be prevented.²⁷ This was not shown in our study. Meazini et al²⁸ and Padwa et al²⁹ also found that the change in mandibular position did not induce maxillary skeletal growth; instead, only a dentoalveolar response was registered. However, since some maxillary skeletal base growth occurs before age 5 years³⁰ and all subjects in our study were older than 5 years, one might find a different reaction from the maxillary skeletal base if the mandibular correction is done on younger patients.²⁸

Ramus height did not improve as much as expected. There were significant discrepancies between treatment and control at all intervals. Parallel growth patterns for the treated and untreated sides through T7 are shown in Figure 3; however, the normal side outpaced the distracted side at T8. The initial ramal height difference at T1 was -13.80 mm; the final difference was -18.85 mm. The greater discrepancy at 5 years postdistraction also suggests that the control side might have a relatively greater programmed growth rate, whereas the affected side lags behind. In agreement with our findings, Grayson et al³¹ discovered that “the increase in ramus height over 5 years of growth is greater on the side that was not distracted; over-correction is therefore recommended in the growing child.”

For maxillary width, the changes in the treatment means from the control means were not different among the various intervals. Moreover, the similarity of values between the treatment and control means at T1 (mean difference, -0.70 mm) and T8 (mean difference, -0.75 mm) indicates that there might be no long-term change before and after distraction. This can be explained since the transverse plane is the first to complete its growth (compared with the sagittal and vertical planes), and all subjects were initially at an age when transverse growth was occurring or was near completion.

To determine the extent that DOG played in preventing further asymmetry, future studies are needed to compare our patients with a sample matched for asymmetry who declined DOG treatment. Although not directly stated, the extent of distraction and the severity of the asymmetry varied between patients in this study and can be inferred from Figure 6. By averaging all patients' measurements regardless of severity and extent of distraction (Figs 1-5), we might be making too wide a generalization because the spectrum of mandibular malformation can range from a short ramus to complete absence of the ramus and the temporomandibular joint. Nevertheless, our intent was not to make generalizations due to the small sample size. Instead, we were interested in examining the data trends, and patterns can still be elucidated from grouping all patients together. In addition, by calculating the treatment-control differences (Tables III-IV), we used the subject's own unaffected side as its control and thus eliminated intersubject differences in our comparisons.

In addition to controlling for the severity of asymmetry, it would also be helpful to standardize for age and sex. The subjects' initial ages varied from 7 to 12 years. By grouping all patients together regardless of age and sex, different growth potentials between the subjects were not considered. When looking at subjects and correlating their age with growth potential (Fig 6), 1 subject, an 8-year-old girl, might have a relatively larger growth potential that also helped achieve comparatively greater improvements toward the skeletal midline from the end of expansion (T2) to 3 months after removal of the device (T4). On the other hand, an 11-year-old boy, seemed to have much less growth potential, with mild skeletal improvements during the same time period. To better correlate age and growth potential, more subjects should be included and matched according to initial age at the start of the treatment.

As with all clinical studies, the small sample size in both the pilot study and this long-term research made it difficult to draw conclusions and make generalizations. By enrolling more subjects, the power of the study could be greatly enhanced. Both superimposition and magnification errors, no matter how small, can cause inaccurate assessments with traditional radiography. With cone-beam computed tomography, we can now eliminate image superimposition and make exact scale measurements in 3 dimensions.³²

CONCLUSIONS

Maxillary height, ramus height, mandibular length, and chin point deviation all had moderate improvements after distraction. Although the growth patterns between the control and treated sides are comparable until 2 years postdistraction, the normal side seemed to outgrow the distracted side until 5 years postdistraction. Therefore, more overcorrection than originally thought necessary is needed to minimize the persistent asymmetry in chin point deviation and mandibular length in a growing patient, in addition to the expected relapse.

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Fig 1.

Mean maxillary width (distance in millimeters from vertical plane to J point) vs time (study intervals). Error bars represent the associated standard deviation for each data point (*Pre-Op*, predistractor placement; *End of Exp*, end of distraction; *Removal*, time of distractor removal; *6 mo post*, 6 months after device removal; *12 mo post*, 12 months after device removal; *24 mo post*, 24 months after device removal; *60 mo post*, 60 months after device removal).

Fig 2.

Mean occlusal height (distance in millimeters from horizontal plane to contact point between maxillary and mandibular molars) vs time (study intervals). Error bars represent the associated standard deviation for each data point.

Fig 3.

Ramus height (distance in millimeters from horizontal plane to antegonial notch) vs time (study intervals). Error bars represent the associated standard deviation for each data point.

Fig 4. Mean mandibular length (distance measured in millimeters from menton to condylion) vs time (study intervals). Error bars represent the associated standard deviation for each data point.

Fig 5.
Mean chin point deviation (distance in millimeters from menton to vertical plane) vs time (study intervals). Error bars represent the associated standard deviation for each data point.

Fig 6.
Chin point deviation vs time for each subject.

Fig 7.

Facial photos of a patient at T1, T3, T7, and T8, showing chin point at different times (photos at T1, T3, and T7; reprinted from Trahar et al¹¹ with permission from Elsevier). *T1*, Preoperative; *T3*, device removal; *T7*, 24 months after removal; *T8*, 60 months after removal.

Patient summary, including ages at the beginning of the pilot study and the end of this follow-up study, and dates when the radiographs were taken

Table 1

<i>Patient</i>	<i>Age 1</i>	<i>T1</i>	<i>T2</i>	<i>T3</i>	<i>Age 2</i>	<i>Sex</i>	<i>Diagnosis</i>
1	11	10/15/1996	02/04/1997	04/29/1997	18	M	Right HFM
2	12	01/13/1997	03/07/1997	04/15/1997	19	M	Right HFM
3	8	02/18/1997	06/06/1997	07/10/1997	15	F	Left HFM
4	7	03/13/2000	None	10/13/2000	13	F	Left HFM

Age 1, Pilot study; *age 2*, current study; *M*, male; *F*, female.

The dates for T2 might not be the actual dates when distraction was terminated; therefore, the actual extent of distraction cannot simply be calculated from T1 to T2. Instead, the extent of distraction varies between patients and can be inferred from Figure 4. The goal was to decrease asymmetry by performing distraction.

Table II

Records collected at each time interval (T1-T7 and the associated records taken were the same for the pilot study)

<i>Interval</i>	<i>Radiographs</i>	<i>Photographs</i>
Preoperative (T1)	Full set	X
Postoperative	Panoramic	
During expansion	Panoramic, SMV	
End of expansion (T2)	Lateral, PA ceph, left/right 45° oblique ceph, PANO, SMV	
Device removal (T3)	Full set	X
3 mo postremoval (T4)	Lateral, PA ceph, left/right 45° oblique ceph, PANO, SMV	X
6 mo postremoval (T5)	Lateral, PA ceph, left/right 45° oblique ceph, PANO, SMV	X
12 mo postremoval (T6)	Full set	X
24 mo postremoval (T7)	Full set	X
60 mo postremoval (T8)	Lateral, PA ceph, left/right 45° oblique ceph, PANO, SMV	X

Ceph, Cephalograph; *SMV*, submentoverte.

Table III

Pairwise comparisons for T1 through T8 for maxillary height (T1 vs T2-T7 were published in the pilot study for the original 6 subjects)

<i>Time vs</i>	<i>Time</i>	<i>Mean difference</i>	<i>t value</i>	<i>P value</i>
1	2	-0.40	-0.34	0.7693
1	3	-1.55	-1.97	0.1431
1	4	-2.03	-1.96	0.1888
1	5	-2.03	-1.50	0.2309
1	6	-.35	-1.34	0.2732
1	7	-1.60	-3.67	0.0669
1	8	1.48	1.64	0.2002
2	3	-0.47	-0.68	0.5655
2	4	-1.63	-2.49	0.1307
2	5	-0.47	-0.57	0.6264
2	6	-0.43	-0.55	0.6359
2	7	-1.20	-1.57	0.2567
2	8	1.10	1.32	0.3174
3	4	-1.17	-2.17	0.1617
3	5	-0.48	-0.77	0.4957
3	6	0.20	0.36	0.7406
3	7	-0.73	-5.50	0.0315
3	8	3.03	2.05	0.1322
4	5	1.17	6.61	0.0221
4	6	1.20	5.76	0.0288
4	7	0.43	0.65	0.5837
4	8	2.73	6.74	0.0213
5	6	0.68	1.01	0.3864
5	7	-0.73	-1.09	0.3903
5	8	3.50	1.80	0.1702
6	7	-0.77	-0.88	0.4730
6	8	2.83	2.09	0.1284
7	8	2.30	6.08	0.0260

Table IV

Pairwise comparisons for T1 through T8 for occlusal height (T1 vs T2-T7 were published in the pilot study for the original 6 subjects)

<i>Time vs</i>	<i>Time</i>	<i>Mean difference</i>	<i>t value</i>	<i>P value</i>
1	2	-0.5333	-0.9942	0.4249
1	3	-0.1250	-0.2231	0.8378
1	4	-0.5333	-0.6576	0.5784
1	5	-0.9750	-1.1746	0.3249
1	6	-1.1500	-1.0977	0.3525
1	7	-1.3667	-1.3751	0.3029
1	8	-0.6250	-0.4840	0.6615
2	3	0.2667	0.4971	0.6684
2	4	0.0000	0.0000	1.0000
2	5	0.2667	1.1429	0.3715
2	6	0.2000	0.5000	0.6667
2	7	-0.8333	-0.9449	0.4444
2	8	-0.4667	-0.3578	0.7547
3	4	-0.2667	-0.7663	0.5236
3	5	-0.8500	-0.9692	0.4039
3	6	-1.0250	-0.9374	0.4177
3	7	-1.1000	-0.7759	0.5190
3	8	-0.5000	-0.4094	0.7097
4	5	0.2667	1.3152	0.3190
4	6	0.2000	0.4949	0.6697
4	7	-0.8333	-0.7040	0.5544
4	8	-0.4667	-0.3461	0.7623
5	6	-0.1750	-0.4811	0.6633
5	7	-1.1000	-0.9865	0.4279
5	8	0.3500	0.2350	0.8293
6	7	-1.0333	-1.1521	0.3684
6	8	0.5250	0.3832	0.7271
7	8	0.3667	0.3443	0.7635