Introduction: The purpose of this study was to investigate the responses of mandibular condylar cartilage to moving 2 molars in different combinations.

Methods: Rats were assigned to male and female control and experimental groups (each, n = 5). Elastic rubber bands were used to move medially the maxillary left and the mandibular right first molars in experimental group I. The same method was used to distally move the maxillary left and the mandibular right third molars, 2 mandibular third molars, and 2 maxillary third molars in experimental groups II, III, and IV, respectively. At the end of the eighth week, all condyles were examined histologically. The areas of histologic change as a percentage of total cartilage area were compared by using the Mann-Whitney U test.

Results: Cartilage degenerative remodeling was observed in experimental groups II, III, and IV. The percentage areas of degenerative remodeling were higher in female experimental groups II and III than in the female control group, and in female experimental group II than in female experimental group IV and male experimental group II (all, \( P < 0.05 \)).

Conclusions: The mandibular condylar cartilage of female rats responded variously to different combinations of molar movement; the most obvious remodeling was observed in groups in which the maxillary left and mandibular right third molars were moved.

Read the full text online at: www.ajodo.org, pages 460.e1-460.e8.

EDITOR'S COMMENT

With more interest being shown in evidence-based orthodontic research, and with added interest given to more well-defined etiologic factors in temporomandibular disorders (TMD), the possible link between TMD and orthodontic treatment merits further discussion. The possible role of occlusion in the development and progression of TMD has been investigated at great length. Evidence strongly suggests that occlusion is a minor etiologic factor in TMD, and equally strong and convincing evidence points to TMD as multifactorial in its onset and progression. Because orthodontic treatment is focused on the functional and esthetic alteration of the dentofacial complex, questions concerning the relationship of an orthodontically altered occlusion and the integrity of the masticatory system, including the temporomandibular joints, continue to be raised. The purpose of this study was to investigate the responses of condylar cartilage in rats to occlusal changes after orthodontic movement of various molars. The authors concentrated on the histologic changes in the cartilage after moving teeth mesially and distally, and allowing for normal function before analysis.

Elastics between the first and second molars were used to move molars orthodontically in 50 rats. Standard movement was approximately 0.8 mm in each group. A different combination of teeth was moved in each of 4 groups, with a fifth group as the control. Once movement was complete, the molar positions were retained with self-curing resin, and normal mastication continued as it had during the treatment phase. The animals were killed 8 weeks after final dental movement, and the temporomandibular joints were studied histologically. The authors also compared the occlusal makeup of the rats before and after movement and attempted to correlate occlusal changes to joint alterations. Interesting sex-related findings were reported. Although no strict extrapolation was carried out regarding human occlusal findings relative to TMD, the authors discussed how their findings might help to explain previously reported sex differences in TMD populations.

John W. Stockstill, Associate Editor
Augusta, Ga
Q & A

Stockstill: Is it realistic to infer that occlusal findings at histologic levels in animals might suggest similar cause-and-effect relationships in humans?

Wang: I do not think so. There are anatomic differences in the morphology and function of molars and TMJs between humans and rats that make extrapolation of these histologic findings to the clinical situation difficult. Therefore, it is important to realize that this study provided only evidence-based findings that altered molar occlusion could induce degenerative histologic remodeling in rats’ TMJ cartilage, with a sex difference in the response. Future clinical trials on the outcome of occlusal treatments in humans might provide more information to further confirm whether there are cause-and-effect relationships between abnormal occlusion and TMD. A supportive study was reported recently.1

Stockstill: Is the rat TMJ a realistically similar model for comparison to the human TMJ in terms of lever systems and loading mechanics?

Wang: We had once observed and compared the anatomic features of TMJs in 4 animals—rats, cats, goats, and monkeys. Cats, the carnivores, have hinge-like TMJs and half-ring-like discs with even thickness, indicating a sort of biomechanical joint loading with a single rotating movement of their TMJs. Rats, goats, and monkeys, however, have dumbbell-shaped discs quite similar to humans, although their condyle shape is different. TMJs with dumbbell-shaped discs can support not only rotating but also gliding movements. In this sense, a rat’s TMJ might be similar to a human TMJ, although we have not yet found any comparative studies on the lever systems and loading mechanics between rat and human TMJs. In addition, rats have been widely used in studies of the effects of altered occlusion and mandibular functional shift on the histologic changes of TMJ cartilage.2–6 A comparative evaluation of the lever systems and loading mechanics between rat and human TMJs is attractive and worthwhile to be investigated in the future.

Stockstill: Was the posttreatment occlusal scheme in each group sufficiently retained for an adequate time to allow for observable changes in the TMJs?

Wang: Whether the treatment period is sufficient to evoke observable changes in the TMJs needs further investigation. A series of sampling times, such as 2, 4, and 6 weeks after the start of the experiment, will be worth performing for a more confirmative result. If there won’t be any changes at 2, 4, and 6 weeks after the start of the experiment, the possible effects of a longer period should be observed. Since no obvious histologic changes were observed in response to mesial movement of the maxillary left and mandibular right first molars after 8 weeks, the possibility might be low that longer treatment would induce some degenerative remodeling of mandibular cartilage in that group.

Stockstill: Do you plan any finite element analysis studies using these samples to more closely define the role of altered occlusion, if any, in observable TMJ changes in the rat?

Wang: Actually, we have tried to use finite element analysis to further investigate TMJ loading changes in response to different combinations of molar movement in rats. However, the occlusal surfaces of rats’ molars are so complicated, not as regular as humans’; that makes it difficult to accurately scan and reconstruct them in a well-matched occlusion. We hope to find some way to resolve this problem in the future. Microcomputed tomography, with 8 μm of spatial resolution, might be helpful in scanning and reconstructing rats’ molars for further study.

REFERENCES