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ORIGINAL ARTICLE AJO-DO

Continuous arch and rectangular loops for the correction of consistent and inconsistent load systems in extruded and tipped maxillary second molars

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Introduction: The aim of this research was to compare the load systems produced by rectangular loops and continuous arches for the correction of extruded second molars with a mesial inclination (inconsistent system) and a distal inclination (consistent system). **Methods:** The maxillary first molar of an acrylic model of a patient, with passive brackets and tubes bonded, was connected to a 3-dimensional load cell of an orthodontic force tester, and the second molar was replaced by its respective tube bonded to a second load cell. The second molar tube was moved 2.5 mm occlusally and tipped 20° mesially and distally, creating an inconsistent force system and a consistent force system. For each situation, ten 0.017 × 0.025-in beta-titanium, 8 × 10-mm rectangular loops were compared with 10 0.014-in nickel-titanium continuous arches. The vertical forces—F(z)—and tipping moments—M(x)—were compared using 4 *t* tests, at 5%. **Results:** In the inconsistent group, the rectangular loop produced a larger M(x) in both molars: 2.11 N.mm in the second molar compared with the −0.15 N.mm of the continuous arches. On the first molar, the rectangular loops produced −5.58 N.mm against −2.08 N.mm produced by the continuous arches. The F(z) values produced at the second molar with each system were similar, whereas on the first molar they were different; the rectangular loops produced 0.41N, and continuous arches produced 0.53N. In the consistent group, the rectangular loops produced smaller M(x) values at the second molar (−3.06 N.mm) than did the continuous arch (−4.25 N.mm) ($P = 0.01$), as well as a smaller F(z) value (−0.52 vs −0.92 N, respectively). At the first molar, the rectangular loops produced smaller M(x) values (−2.32 N.mm) than did the continuous arch (−4.18 N.mm), as well as a smaller F(z) value (0.59 vs 1.10 N). **Conclusions:** In the inconsistent group, only the rectangular loop produced a system of force that could correct the second molar. In the consistent system, both group mechanics produced a system of force compatible with the correction of the second molar, but the continuous wire produced larger moments. Both groups showed a tendency for mesial crown tipping of the first molar. (Am J Orthod Dentofacial Orthop 2018;153:396-404)

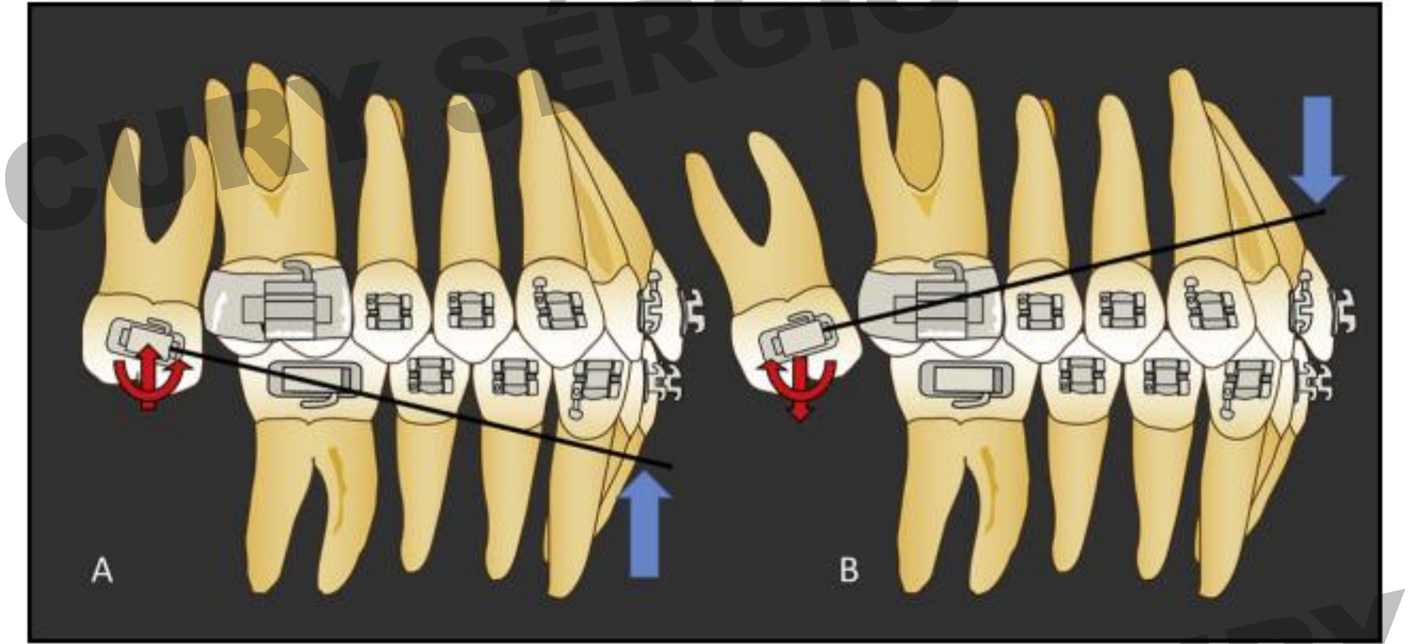


Fig 1. A, A maxillary second molar extruded with distal-crown tipping. Upon inserting a straight wire into the second molar tube (*black line*) and placing a force to engage it to the other brackets (*blue arrow*), an intrusive (desired) force with a mesial-crown tipping tendency (desired) is expected to occur. Because the estimated load system matches the one desired to correct the tooth, the load system is called consistent. **B,** A maxillary second molar extruded with mesial-crown tipping. Upon inserting a continuous arch into the second molar tube (*black line*) and placing a force to engage it to the other brackets (*blue arrow*), an extrusive force (unwanted) with a distal-crown tipping tendency (desired) is expected to occur. Since the estimated load system does not match the desired one to correct the second molar, the load system is termed inconsistent.

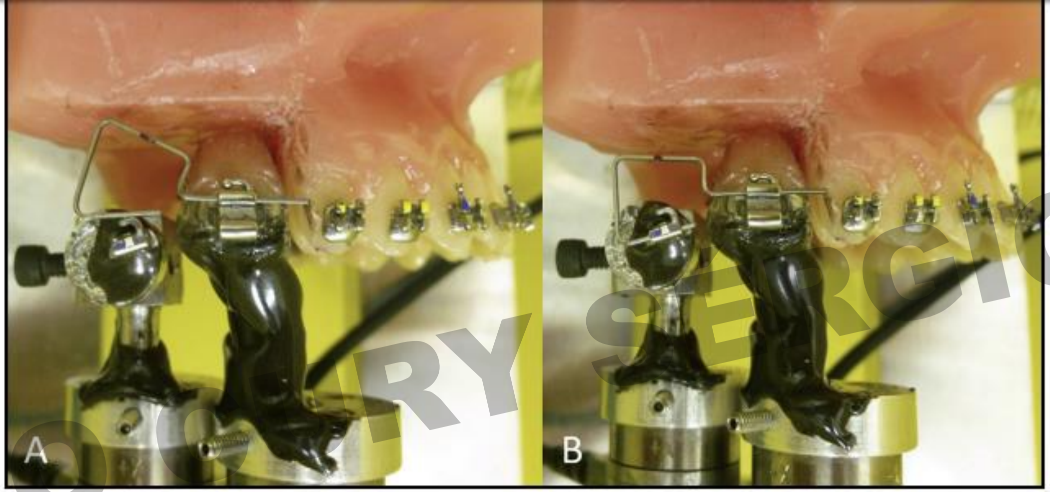
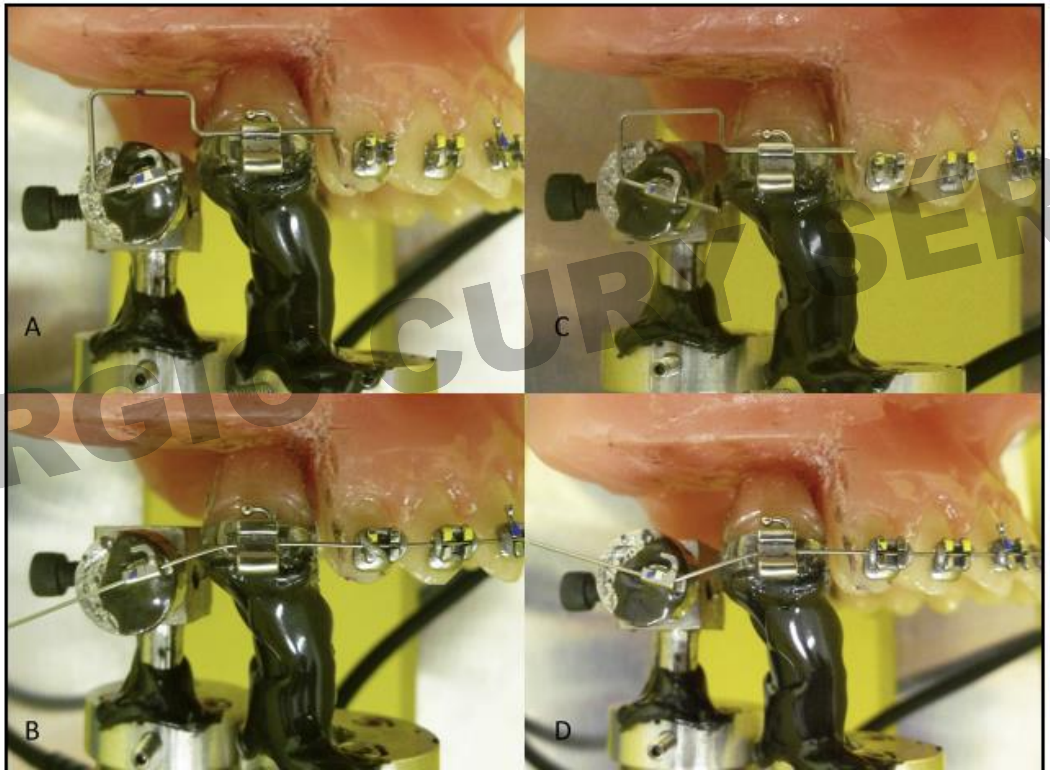


Fig 4. A, Preactivated rectangular loop; **B,** activated rectangular loop engaged to the second molar tube. (The images were inverted vertically and horizontally.)



ORIGINAL ARTICLE CE AJO-DO

Photoelastic analysis of stress distribution in mandibular second molar roots caused by several uprighting mechanics

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Introduction: Mandibular molar uprighting is indicated when mesial inclination of the second molars occurs because of missing first molars. There are many methodologies to perform such movement. In this study, we aimed to analyze and compare the stress distributions in different molar uprighting techniques. **Methods:** Four photoelastic models were designed to evaluate different mandibular second molar uprighting techniques: a miniscrew positioned in the retromolar region, a beta-titanium alloy cantilever spring, a beta-titanium alloy wire with a T-loop spring, and an 0.018-in stainless steel archwire with an open-coil spring between the second premolar and the second molar. **Results:** On the miniscrew test specimen, the greatest concentration of strains was observed in the cervical zone of the distal root. The cantilever spring had many strains in the cervical zone of the mesial root. On the T-loop spring test specimen, mainly the observed strains were in the apical zone of the mesial root. The open-coil spring specimen showed fringes in the cervical zone and the apical zone of the mesial root without formation of large sequences of strains. **Conclusions:** The miniscrew mechanical action had the least and the cantilever spring mechanical action had the greatest strain means on the roots of mandibular second molars. (Am J Orthod Dentofacial Orthop 2018;153:415-21)

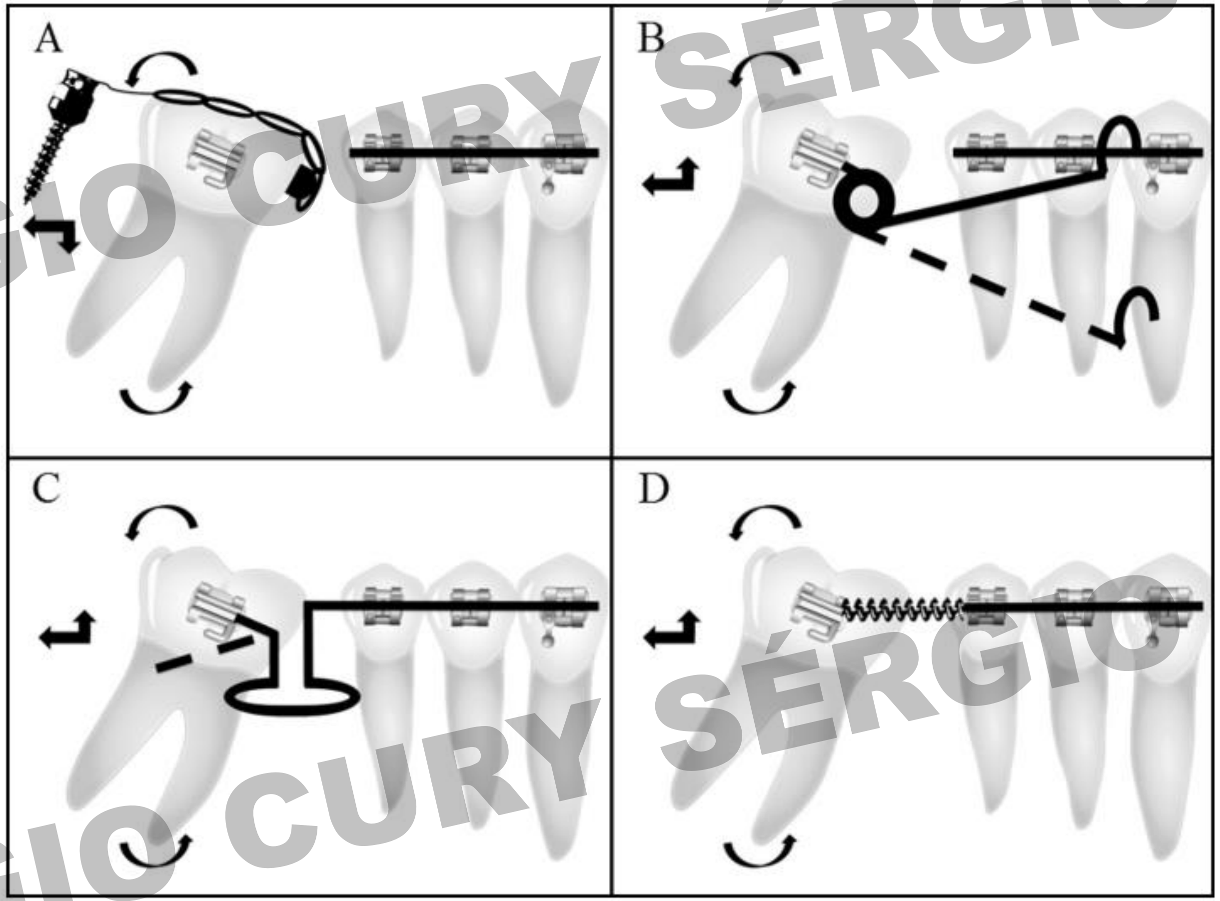

Fig 5. Moment of force diagram of each studied type of mechanics: **A,** miniscrew activation with elastic power chain passing over the second molar, creating distal inclination of the crown and mesial inclination of the root, which results in molar uprighting with distalization and intrusion components; **B, C,** and **D,** respectively, cantilever spring activation, T-loop spring activation, and open-coil spring activation, all of them creating distal inclination of the crown and mesial inclination of the root, which results in molar uprighting with distalization and extrusion components.

AJO-DO

Interdisciplinary treatment for a compensated Class II partially edentulous malocclusion: Orthodontic creation of a posterior implant site

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A 36-year-old woman with good periodontal health sought treatment for a compensated Class II partially edentulous malocclusion associated with a steep mandibular plane (SN-MP, 45°), 9 missing teeth, a 3-mm midline discrepancy, and compromised posterior occlusal function. She had multiple carious lesions, a failing fixed prostheses in the mandibular right quadrant replacing the right first molar, and a severely atrophic edentulous ridge in the area around the mandibular left first and second molars. After restoration of the caries, the mandibular left third molar served as anchorage to correct the mandibular arch crowding. The mandibular left second premolar was retracted with a light force of 2 oz (about 28.3 cN) on the buccal and lingual surfaces to create an implant site between the premolars. Modest lateral root resorption was noted on the distal surface of the mandibular left second premolar after about 7 mm of distal translation in 7 months. Six months later, implants were placed in the mandibular left and right quadrants; the spaces were retained with the fixed appliance for 5 months and a removable retainer for 1 month. Poor cooperation resulted in relapse of the mandibular left second premolar back into the implant site, and it was necessary to reopen the space. When the mandibular left fixture was uncovered, a 3-mm deep osseous defect on the distobuccal surface was found; it was an area of relatively immature bundle bone, because the distal aspect of the space was reopened after the relapse. Subsequent bone grafting resulted in good osseous support of the implant-supported prosthesis. The relatively thin band of attached gingiva on the implant at the mandibular right first molar healed with a recessed contour that was susceptible to food impaction. A free gingival graft restored soft tissue form and function. This severe malocclusion with a discrepancy index value of 28 was treated to an excellent outcome in 38 months of interdisciplinary treatment. The Cast-Radiograph Evaluation score was 13. However, the treatment was complicated by routine relapse and implant osseous support problems. Retreatment of space opening and 2 additional surgeries were required to correct an osseous defect and an inadequate soft tissue contour. Orthodontic treatment is a viable option for creating implant sites, but fixed retention is required until the prosthesis is delivered. Bone augmentation is indicated at the time of implant placement to offset expected bone loss. Complex restorative treatment may result in routine complications that are effectively managed with interdisciplinary care. (Am J Orthod Dentofacial Orthop 2018;153:422-35)

Fig 8. Month 0, irregular dentition at the start of active treatment. Month 7, the mandibular left segment is being aligned, and the edentulous space is decreased; note the lingual elastic chain between the left molar and second premolar. Month 16, the initial alignment is complete.

lingual button and power chain were placed on the mandibular left third molar to provide a mesial protrac-

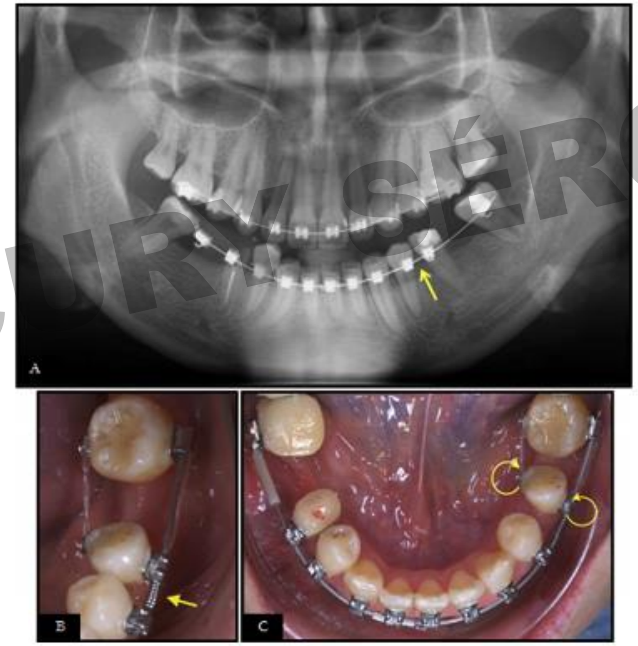

Fig 9. A, The mandibular left space (first molar) was reduced, space opening begins (*arrow*), and the mandibular right space (first molar) was maintained. **B,** The edentulous ridge for the right first molar space was very narrow, so the second premolar was moved distally with an open-coil spring (*arrow*) on the buccal surface. **C,** Buttons with power chains on the lingual surface resulted in equal retraction loads on both surfaces.

root resorption. After 7 months of retracting the mandibular left second premolar at a rate of 1 mm per month, the orthodontically generated implant site was about 7 mm in length (Fig 10). The space was maintained for 6 months with fixed appliances. A periapical radiograph showed only minor lateral root resorption on the distal side of the root of the second premolar (Fig 10).

Extraction of blocked-out permanent teeth (maxillary right second molar and first premolar, and left

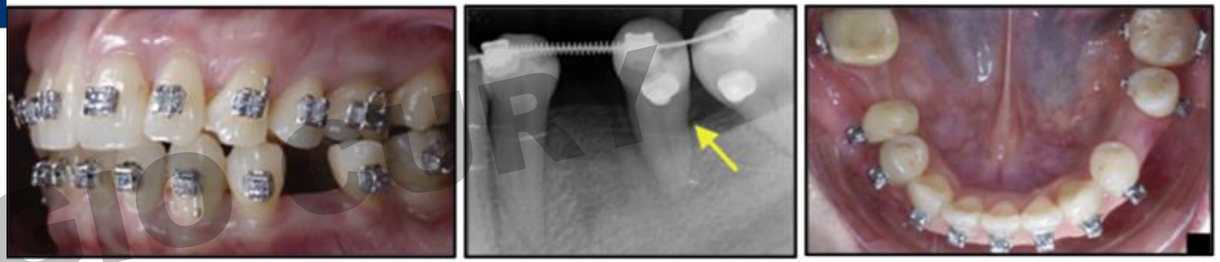

Fig 10. The mandibular left second premolar was moved into the edentulous ridge in the area of the first molar, and a small area of lateral root resorption was noted (*arrow*).

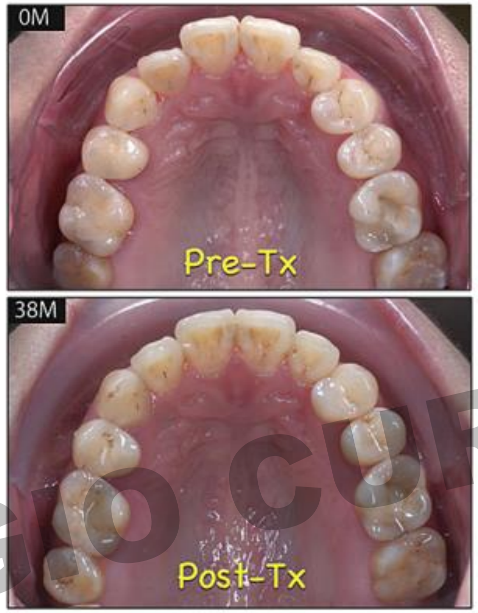

Fig 11. The pretreatment (*Pre-Tx*) maxillary arch form (0M) is compared with the posttreatment (*Post-Tx*) result at 38 months.

A horizontal incision was made with a number 12 blade from the lingual line angle of the mandibular left first premolar to the mesial line angle of the second premolar (moved into the position of the first molar). Two vertical releasing incisions were made with a number 15 blade and joined with the horizontal incisions. The incisions were 1.5 mm from the adjacent teeth for

the attachment (Fig 12, *H*).[11] A guide pin (Fig 12, *I*) was used to check the insertion path and orientation of the osteotomy. The osteotomy site was prepared according to the protocol of the manufacturer, and a 3.5 × 10-mm implant was installed (Prima; Keystone Dental, Burlington, Mass). As shown in Figure 12, *J* and *K*, the implant was placed in the center of the ridge and was completely embedded (submerged) in bone. Furthermore, about a 1.5-mm thickness of bone remained on the buccal surface after implant placement (Fig 12, *J*). There was primary closure of the wound with interrupted 5-0 nylon sutures (Fig 12, *L*).

A similar procedure was performed on the mandibular right edentulous ridge in the area of the first molar (Fig 13, *A-H*). However, the ridge was narrower in the crestal area and after implant placement, there was a 1-mm bony dehiscence noted at the buccal crest of the implant (Fig 13, *F*). The healing abutment was installed, and a composite particulate bone graft was placed (Fig 13, *G*), composed of freeze-dried bone allograft (Maxxeus Dental, Kettering, Ohio) and Bio-Oss (Geistlich Pharma North America, Princeton, NJ). The flap was then primarily closed with 5-0 nylon. Freeze-dried bone allograft is composed of cortico-cancellous human bone granules that serve as a scaffold for osteoconduction, but the graft material is eventually remodeled to living bone. Bio-Oss is a preparation of sterile, dense bovine cancellous granules that also serves as a scaffold for bone deposition, but the graft material is turned over t[illegible] slowly.

Both wounds healed uneventfully, and the [illegible] spaces were maintained with a plastic sheath on the right side