**Figure 7.**

An overview of the histologic appearance of the supracrestal tissues in an experimental animal sacrificed 49 days after injection (H & E stain; original magnification  $\times 31.5$ ).

**Figure 8.**

A higher magnification of the gingival unit shown in Figure 7, which indicates the level of apical migration of the junctional epithelium and no significant local inflammation (H & E stain; original magnification  $\times 125$ ).

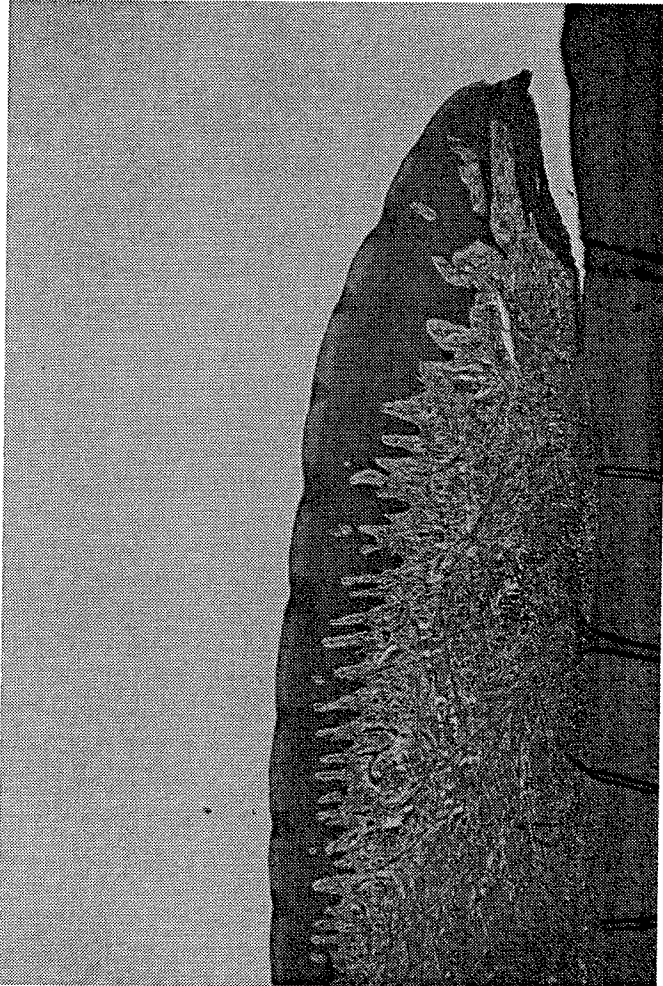
surface of the cementum and bone were reported in areas that previously demonstrated resorption. These studies concluded that repair and reestablishment of a normal physiologic state were achieved. Brannstrom and coworkers, however, questioned the benefits of the technique when they found that permanent tissue damage affecting alveolar bone support and tooth structure can occur.<sup>2</sup>

In 1981, Pashley and coworkers were the first to report on fluid pressure during the injection process.<sup>18</sup> Pressure in excess of 600 psi could be created when maximum force is applied to the syringe plunger. Similar forces may occur when administering a PDL injection with a traditional hand-held syringe.<sup>18</sup> Walton and Garnick stated that pistol-grip, high-pressure syringe systems could develop at least twice the pressure (1,200 psi) when compared to a conventional hand-held syringe.<sup>3</sup> Pertot and Dejou studied the correla-

tion between osteoclastic activity and fluid pressure within the periodontal ligament.<sup>17</sup> Their study demonstrated a direct association between increased pressure and increased osteoclastic activity. The majority of the negative sequelae exhibited during the PDL injection thus could be attributed to the traumatic forces generated from the potentially high pressures produced during a PDL injection using traditional delivery systems.<sup>17</sup>

In an attempt to avoid these problems, a computer-controlled local anesthesia delivery system designed to maintain a precise flow rate and controlled pressure in tissues of high density such as the periodontal ligament has been introduced.<sup>19</sup> This ability to control both flow rate and injection pressure is unique to the CCLADS in local anesthesia.<sup>20</sup>

The present study used a greater volume (1.0 cc)



**Figure 9.** Histologic appearance of a control specimen at 49 days. No histologic abnormalities were noted.

than has been previously reported.<sup>2-8,21</sup> Histologic review of tissue responses following intraligament injections using a computer-controlled local anesthetic delivery service showed limited inflammatory responses to the injury within the first 24 hours following injection. The responses observed in this study abated by 7 days postinjection, but apical migration of the junctional epithelium was seen by that time interval. Since the junctional epithelial migration was confined to the extent of the notch in both experimental and control specimens, it seems likely that this tissue response was related to mechanical tooth injury during notching of the tooth rather than to the anesthetic injection. Evidence of crestal bone or root resorption was not observed from specimens analyzed. The limited number of experimental sites (16 sites) in this pilot study suggests that future studies are warranted to establish a definitive conclusion regarding the tissue responses and the effects of CCLADS on gingival tissues.

## CONCLUSION

A pilot study was undertaken to determine the histologic effect of an intraligament injection in an animal model using a computer-controlled local anesthetic delivery system. A volume of 1.0 cc of anesthetic was administered at each experimental site. The following conclusions are presented:

1. Limited inflammatory responses to injury from local anesthetic administration were observed during the first 24 hours.

2. Apical migration of the junctional epithelium was noted at day 7 for both the experimental and control teeth and was attributed to subgingival notching of the teeth.

3. No apparent histologic changes occurred in the latter time periods of the experiment. Therefore, we concluded that there were no lasting histological changes following the injections.

4. No apparent inflammatory changes in the periodontium were noted on day 49.

Further investigations are necessary to determine whether the histologic findings in this pilot study using a CCLADS in mini-swine will translate to clinical benefits in the human model.

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