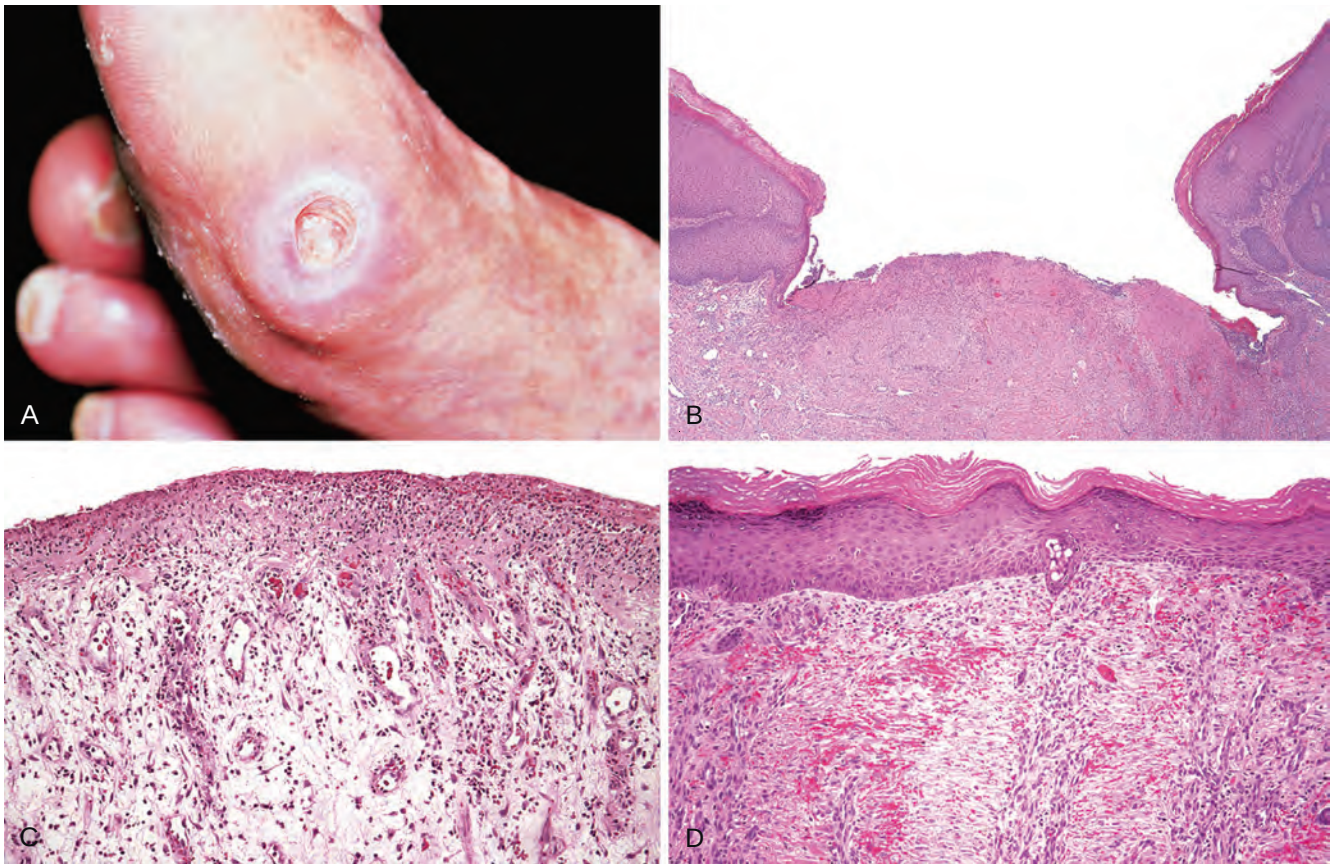

Figure 3-30 Healing of skin ulcers. **A,** Pressure ulcer of the skin, commonly found in diabetic patients. The histologic slides show a skin ulcer with a large gap between the edges of the lesion **(B),** a thin layer of epidermal reepithelialization and extensive granulation tissue formation in the dermis **(C),** and continuing reepithelialization of the epidermis and wound contraction **(D).** (Courtesy Z. Argenyi, MD, University of Washington, Seattle, Wash.)

inflammatory reaction is more intense, there is development of abundant granulation tissue, accumulation of ECM and formation of a large scar, and wound contraction by the action of myofibroblasts.

Secondary healing differs from primary healing in several respects:

- In wounds causing large tissue deficits, the fibrin clot is larger, and there is more exudate and necrotic debris in the wounded area. Inflammation is more intense because large tissue defects have a greater volume of necrotic debris, exudate, and fibrin that must be removed. Consequently, large defects have a greater potential for secondary, inflammation-mediated, injury.
- Much larger amounts of granulation tissue are formed. Larger defects require a greater volume of granulation tissue to fill in the gaps and provide the underlying framework for the regrowth of tissue epithelium. A greater volume of granulation tissue generally results in a greater mass of scar tissue.
- At first a provisional matrix containing fibrin, plasma fibronectin, and type III collagen is formed, but in about 2 weeks this is replaced by a matrix composed primarily of type I collagen. Ultimately, the original granulation tissue scaffold is converted into a pale, avascular scar, composed of spindle-shaped fibroblasts, dense collagen, fragments of elastic tissue, and other ECM components. The dermal appendages that have been destroyed in the line of the incision are permanently lost. The epidermis recovers its normal thickness and architecture. By the end of the first month, the scar is made up of acellular connective tissue devoid of inflammatory infiltrate, covered by intact epidermis.
- Wound contraction generally occurs in large surface wounds. The contraction helps to close the wound by decreasing the gap between its dermal edges and by reducing the wound surface area. Hence, it is an important feature in healing by secondary union. The initial steps of wound contraction involve the formation, at the edge of the wound, of a network of *myofibroblasts*, which are modified fibroblasts exhibiting many of the ultrastructural and functional features of contractile smooth muscle cells. Within 6 weeks, large skin defects may be reduced to 5% to 10% of their original size, largely by contraction.

Wound Strength

Carefully sutured wounds have approximately 70% of the strength of normal skin, largely because of the placement of sutures. When sutures are removed, usually at 1 week, wound strength is approximately 10% of that of unwounded skin, but this increases rapidly over the next 4 weeks. The recovery of tensile strength results from the excess of collagen synthesis over collagen degradation during the first 2 months of healing, and, at later times, from structural