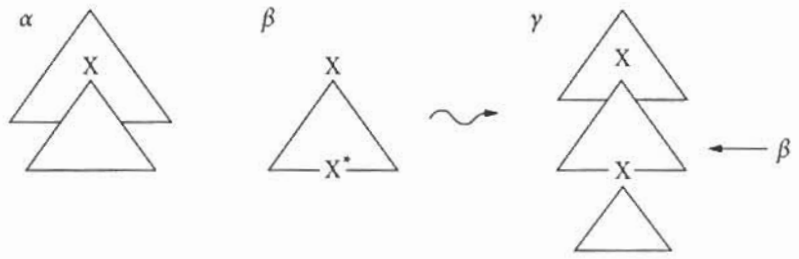

Fig. 26.5 Adjoining

We now introduce a new operation called **adjoining** as shown in Fig. 26.5. Adjoining involves splicing (inserting) one tree into another. More specifically, a tree β as shown in Fig. 26.5 is inserted (adjoined) into the tree α at the node X resulting in the tree γ. The tree β, called an **auxiliary tree**, has a special form. The root node is labelled with a non-terminal, say X, and on the frontier there is also a node labelled X called the foot node (marked with *). There could be other (terminal or non-terminal) nodes on the frontier of β; the non-terminal nodes will be marked as substitution sites (with a vertical arrow). Thus if there is another occurrence of X (other than the foot node marked with *) on the frontier of β it will be marked with the vertical arrow and that will be a substitution site. Given this specification, adjoining β to α at the node X in α is uniquely defined. Adjoining can also be seen as a pair of substitutions as follows: the subtree at X in α is detached, β is substituted at X, and the detached subtree is then substituted at the foot node of β. A tree substitution grammar when augmented with the adjoining operation is called a tree-adjoining grammar (lexicalized tree-adjoining grammar because each elementary tree is lexically anchored). In short, LTAG consists of a finite set of **elementary trees**, each lexicalized with at least one lexical anchor. The elementary trees are either initial or auxiliary trees. Auxiliary trees have been defined already. **Initial** trees are those for which all non-terminal nodes on the frontier are substitution nodes. It can be shown that any CFG can be strongly lexicalized by an LTAG (Joshi and Schabes 1997).

In Fig. 26.6 we show a TSG, G', augmented by the operation of adjoining, which strongly lexicalizes the CFG, G. Note that the LTAG looks the same as the TSG considered in Fig. 26.4. However, now trees α_1 and α_2 are auxiliary trees (marked with *) that can participate in adjoining. Since adjoining can insert a tree in the interior of another tree it is possible to grow both sides of the tree α_1 and tree α_2, which was not possible earlier with substitution alone. In summary, we have shown that by increasing the domain of locality we have achieved the following: (1) lexicalized each elementary domain, (2) introduced an operation of adjoining, which would not be possible without the increased domain of locality (note that with one-level trees as elementary domains adjoining becomes the same as substitution since there are no interior nodes to be operated upon), and (3) achieved strong lexicalization of CFGs.