

Extra Long PR Intervals

Rashid A. Massumi, MD

Cedars-Sinai Medical Center, Los Angeles, CA

This case review presents various manifestations of extra long PR intervals, an interesting form of atrioventricular (AV) block first described in 1977. All patients in this study had organic heart diseases and various combinations of multilevel conduction impairment. Perhaps the most common cause of chronic AV conduction impairment is the ill-defined degenerative and/or fibrotic damage to the intraventricular conduction system.

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In most cases of first-degree atrioventricular (AV) block, the PR intervals range between 210 and 350 ms. During Wenckebach cycles, however, the last PR before the blocked P waves may be considerably longer, up to 450 ms. PR intervals of 600 ms and longer are rare and frequently misinterpreted as mere juxtapositions of the P and R and not actual antegrade AV conduction.

This case report presents 23 cases of extra long PR intervals exceeding 600 ms and 2 cases of extra long RP intervals that were collected and studied with respect to the etiology, symptoms, and natural course of the pattern of AV conduction.

The basic pattern of antegrade AV conduction was first-degree AV block in 6 patients, Wenckebach periodicity in 10 patients, and near complete AV block in 6 patients. One case of bilateral bundle branch block (BBB) with extra long PR in only 1 bundle is included. A total of 15 men and 7 women ranging in age from 36 to 93 years (average age, 72 years) were studied.

The PR intervals were in the 500-ms range in 1 case, in the 600-ms range in 7 cases, in the 700-ms range in 5 cases, in the 800-ms range in 2 cases, and in the 900-ms range in 5 cases. The intervals in excess of 1 second were found in 2 cases and retrograde RP intervals of 890 ms were found in 1 case.

Sick sinus syndrome was common and P waves with abnormal configuration and polarity—suggesting ectopic origins—appeared intermittently in 4 cases. Dizziness, near syncope, and occasional frank syncope were present in 10 cases. Mild to moderate congestive heart failure appeared in 5 cases; 14 patients required pacemaker therapy.

These case reports demonstrate the various manifestations of this interesting form of AV block by presenting representative rhythm strips accompanied by brief descriptions of each. In addition, 2 cases of extremely long RP intervals are presented. Whenever possible, simple ladder diagrams have been drawn for ease of description. In addition, a recent case of bilateral BBB in which conduction through the right bundle branch was 880 ms is presented.

Presentation

Figure 1 depicts 3 cases of 1:1 AV conduction with very long PR intervals. In Case A, the top strip shows the baseline rhythm with 1:1 AV conduction with PR intervals of 1080 ms. The actual presence of AV conduction was documented when a 1:1 AV

relationship persisted after 0.5 mg of atropine was administered intravenously and the atrial rate rose from 37 beats/min to 46 beats/min. The PR intervals became 820 ms at this time.

Case B demonstrates a 1:1 AV relationship with PR intervals of 760 ms. After the premature ventricular contraction (PVC), it may be noted that a 1:1 AV conduction resumes, again with PR intervals of 760 ms.

Case C depicts simultaneously recorded leads V₁ and II. The PR intervals measure 670 ms. The third beat is an interpolated PVC that fails to penetrate the AV node, thus leaving the pattern of antegrade AV conduction undisturbed.

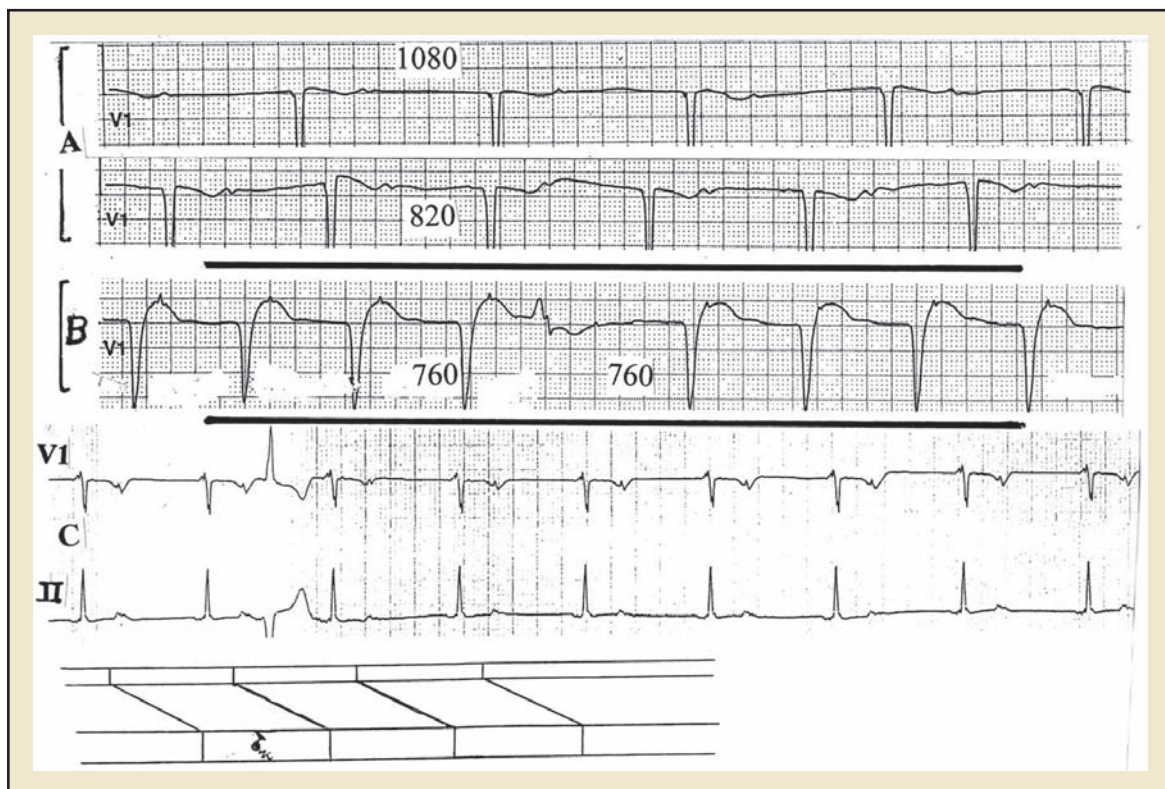
Figure 2 depicts 4 cases of complete AV block. A junctional escape rhythm of 43 beats/min is inter-

rupted by occasional conducted P waves (marked by asterisks). The PR intervals of the conducted P waves range between 860 and 900 ms. Cases B, C, and D are examples of Wenckebach cycles in which the last P waves before blocked P waves are conducted with PR intervals of 820 ms (in case B), 840 ms (in case C), and 760 ms (in case D).

It should be noted that in case B the last PR interval in each Wenckebach cycle is actually longer than the PP interval (860 ms and 900 ms, as compared with 750 ms and 820 ms in case A) resulting in the phenomenon of "P wave skipping." The expression of skipping signifies that the PR interval is so long that it contains 2 P waves, with the second P wave not conducted.

Cases A, B, C, and D in Figure 3 show examples of complete or near

Figure 1. Three cases of 1:1 atrioventricular conduction with very long PR intervals.



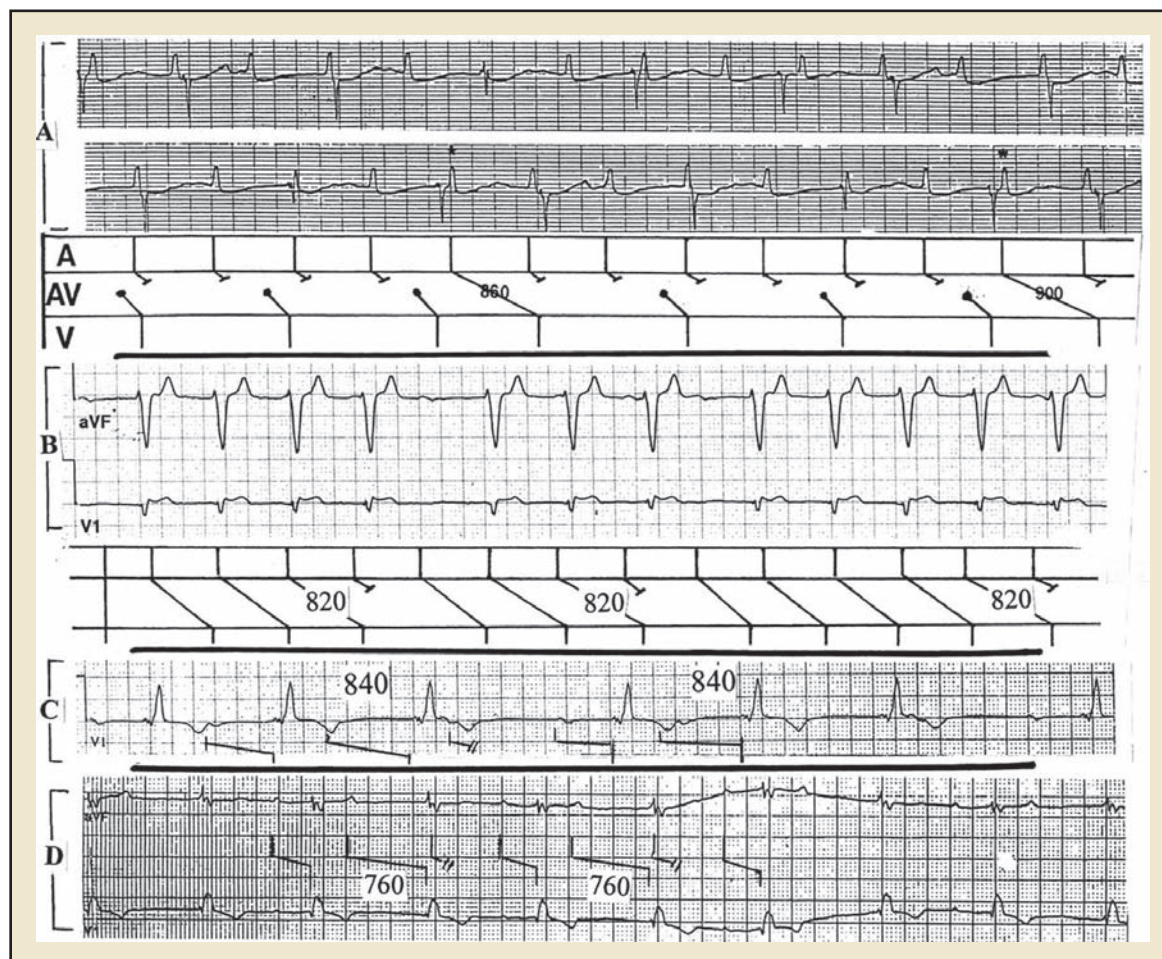


Figure 2. Four cases of complete atrioventricular block. Cases B, C, and D are examples of Wenckebach cycles. A junctional escape rhythm of 43 beats/min is interrupted by occasional conducted P waves (marked by asterisks).

complete AV block with occasional conduction with PR intervals of 760 ms (in case A), 600 ms (in case B), 630 ms (in case C), and 560 ms (in case D). It should be noted that in these cases of advanced AV block, AV conduction occurred only when the P waves coincided with the end of the T waves of the preceding cycle, possibly corresponding to the period of supernormal conduction.

Cases A and B in Figure 4 are examples of very long retrograde conduction times. In case A the pattern of group beating suggests Wenckebach periodicity. The negative polarity of the P waves in lead aVF indicates a retrograde condition.

The groups of 3 R waves separated by pauses can be best ascribed to a junctional rhythm with an exit block of Wenckebach type. The negative P waves in lead aVF can now be accepted as retrograde P waves from junctional discharges, again with a Wenckebach type of decremental conduction. The retrograde conduction times are quite long and reach 840 ms before the appearance of retrograde block. In case B, retrograde ventriculoatrial conduction times of 560 ms and 600 ms are noted after PVCs.

Figure 5 is the electrocardiograph (ECG) and rhythm strip taken from a 56-year-old woman with near syncope. The QRS complexes alternate

between right and left BBB. The PR intervals of right BBB beats measures 400 ms and the beats with left BBB are preceded by PR intervals of 820 ms. The diagram demonstrates the alternation of conduction through the right and left bundle branches, each with its own (but different) conduction time.

Discussion

The first mention of very long PR intervals was found in a 1977 book entitled, *Clinical Vectorcardiography and Electrocardiography*.¹

First-degree AV block is sometimes associated with such marked prolongation of the PR

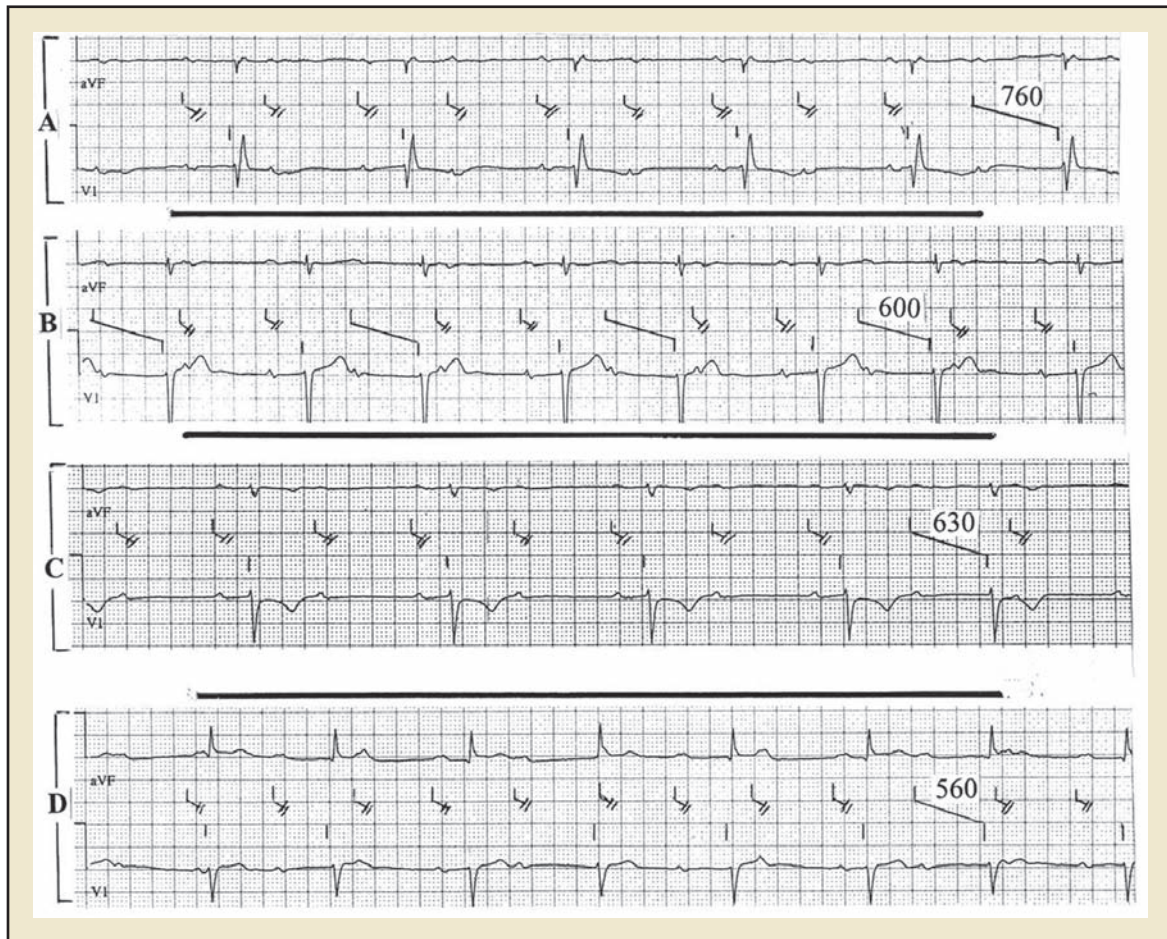


Figure 3. Cases A, B, C, and D show examples of complete or near complete atrioventricular block with occasional conduction.

interval that the latter exceeds the PP interval in length. Thus the sinus beat initiating each ventricular deflection is not the P wave immediately preceding the latter but the P wave before that.

PR intervals as long as 1 second have also been reported.^{2,3} The expression “skipped P waves,” meaning PR intervals exceeding PP intervals, has also been used numerous times. In *Chou’s Electrocardiography in Clinical Practice*⁴ it is noted that PR prolongation in first-degree AV block is usually 0.21 to 0.40 second. Occasionally, the interval is as long as (or longer than) 0.60 second.

In this case study, all patients had organic heart disease with various combinations of multilevel conduction impairment. Implantation of an antibradycardia pacemaker became necessary in 14 of the 23 patients. The patients illustrating very long retrograde conduction times did not require pacemaker therapy.

Patients who were taking digoxin, calcium blockers, or β -blockers were excluded from the study. Moreover, extra long PR intervals were not found in any patients who were taking these drugs for dysrhythmias, hypertension, or coronary artery disease.

The patient in case 5 is very unusual in that the locus of her extra long PR intervals is the left bundle branch. In all the other cases, the level of impaired AV conduction appeared to be the AV node. Extra long PR intervals frequently go unrecognized and the existence of antegrade conduction is doubted. Consequently, the juxtaposition of the P and R is viewed as a mere coincidence. This was indeed the situation in the patients presented in Figure 1. However, the persistence of a 1:1 relationship after the use of intravenous atropine in case A (in Figure 1) and the fortuitous occurrence

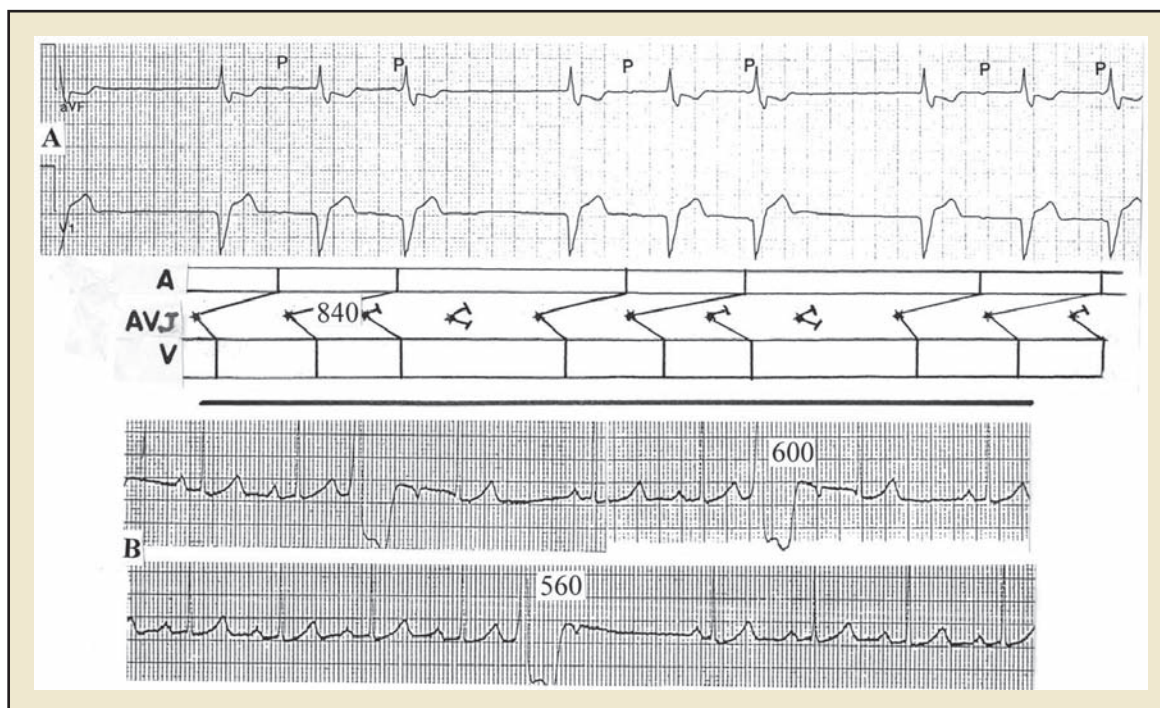


Figure 4. Examples of very long retrograde conduction times. In case A the pattern of group beating suggests Wenckebach periodicity.

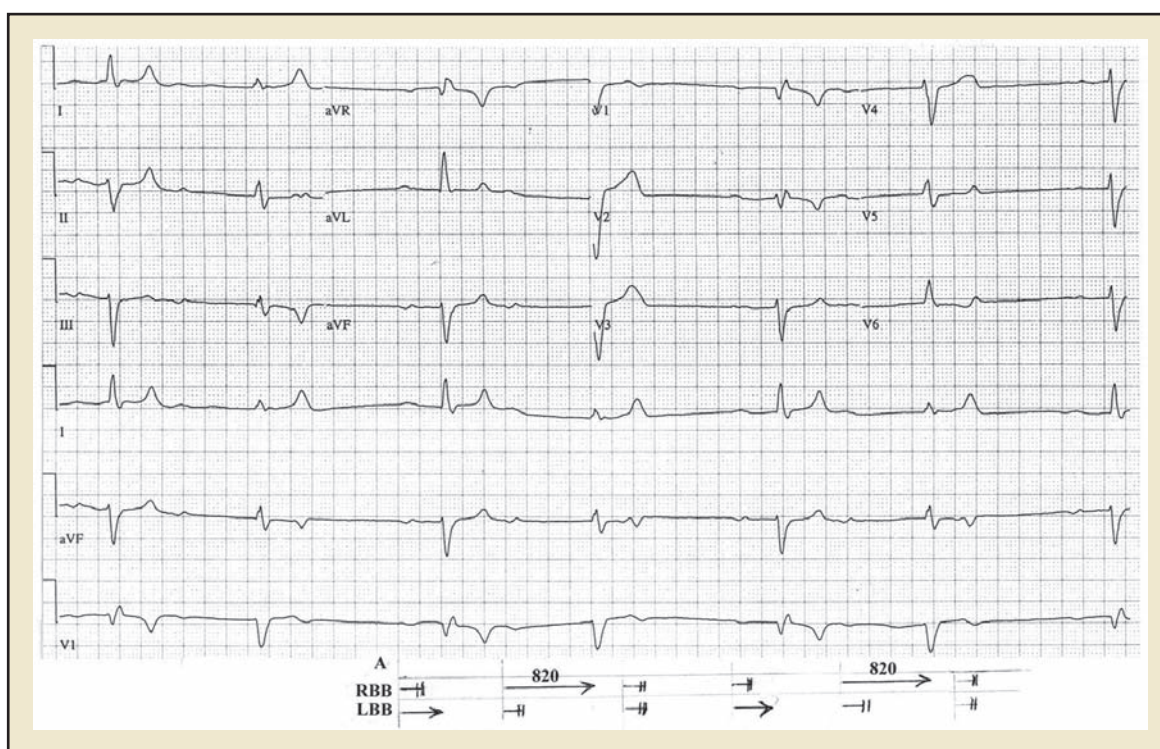


Figure 5. Electrocardiographs and rhythm strip taken from a 56-year-old woman with near syncope. LBB, left bundle branch; RBB, right bundle branch.

of PVC in case B (in Figure 1) proved the existence of AV conduction with very long PR intervals. In terms of etiology, no significant difference between these and other patients in similar age groups with diseased conduction systems was observed.

Ischemic and hypertensive heart disease was present in two-thirds of all cases, and cardiomyopathies of undetermined etiology (eg, senility, left ventricular hypertrophy) were present in one-third. None of the patients were digitoxic. β -blockers and calcium channel blockers were prescribed in 10 patients. However, review of their previous ECGs failed to establish a causative role for these drugs. Table 1 lists the various etiologies of long PR intervals.

Perhaps the most common cause of chronic AV conduction impairment is the ill-defined degenerative and/or fibrotic damage to the intraventricular conduction system (eg Lenge disease, Lev disease). Unfortunately there are no clinical or lab-

Table 1 Major Causes of Long PR Intervals		
Drugs	Inflammatory	Metabolic and Noninflammatory
Digitalis	Rheumatic fever	Hyperkalemia
β -blockers	Lyme disease	Ischemic disease
Calcium channel blockers	Chagas disease	Inferior myocardial infarction Aortic valve disease Amyloidosis

oratory criteria by which these histologic changes can be recognized antemortem.

The hemodynamic effects of very long PR intervals have not been addressed here. It could be speculated that the long hiatus between the atrial contraction and ventricular systole serves as an extension of the diastolic period. As such, it could result in more complete ventricular filling with or without diastolic AV valve regurgitation. ■

References

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Main Points

- Extra long PR intervals are an interesting form of atrioventricular (AV) block.
- Extra long PR intervals frequently go unrecognized and the existence of antegrade conduction is doubled.
- Perhaps the most common cause of chronic AV conduction impairment is the ill-defined degenerative and/or fibrotic damage to the intraventricular conduction system.