# ROLLING BELT INJURIES IN CHILDREN

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**The rolling belts on agricultural machinery attract children who unconsciously grab them. The injuries produced include friction burns, injuries to flexor tendons, digital nerves and arteries, skin in zone 2 and fractures. Subtotal or total amputation may occur.**

**We present the results of such injuries to 44 fingers in 16 children aged 1 to 9. The functional results are not satisfactory. In order to grade the results we have devised a classification to this injury. The survival rate for all fingers was 71%, but in the fingers with circulatory problems the survival rate was 50%. On functional assessment seven patients had a good result, seven moderate, and two fair.**

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Agriculture occupies the majority of the workforce in Turkey. The use of machinery including tractors and water pumps is increasing, especially in summer. The rolling belts on these machines are attractive to children and they unconsciously grab them. The injury this causes is a severe friction burn and damage to the flexor tendons, digital nerves and arteries, and skin in zone 2. Fractures may occur and the injury may involve subtotal or total amputation.

We present the results of treatment of these severe hand injuries, which present great difficulties, and the functional results are not satisfactory.

## MATERIAL AND METHODS

The classification we have used for these injuries is shown in Table 1. All of the 16 cases treated between 1988 and 1992 were aged 1 to 9 years, mean age 3.06. The details are given in Table 2. All of the injuries involved crushing, with friction burns and avulsion caused by a rolling engine belt. There were 13 boys and three girls.

There were four Type 1 fingers, nine Type 2A, eight Type 3A, 13 Type 3B and ten Type 4 fingers.

## RESULTS

44 fingers of 16 patients had various degrees of injury (Table 2). Ten fingers in four patients had total amputations and replantation was attempted in three of them.

**Table 1—Classification of rolling belt injuries**

| | |
|---|---|
| *Type 1* | Only skin lesions |
| *Type 2A* | Skin, tendon, nerve and artery injured, circulation present |
| *Type 2B* | Skin, tendon, nerve and artery injured, circulation absent |
| *Type 3A* | Skin, tendon, nerve, artery and bone injured, circulation present |
| *Type 3B* | Skin, tendon, nerve, artery and bone injured, circulation absent |
| *Type 4* | Total finger amputation |

Revascularization was performed in 11 out of 13 subtotal amputations (Type 3A), osteosynthesis in 27 fingers, primary flexor tendon repair in nine fingers and digital nerve repair in five fingers. Replantation was performed in three out of seven Type 4 injuries.

Full thickness skin grafting was performed to 12 out of 16 cases and local or distant flaps were required in four cases. When possible we covered exposed structures with local soft tissue and free grafts in preference to

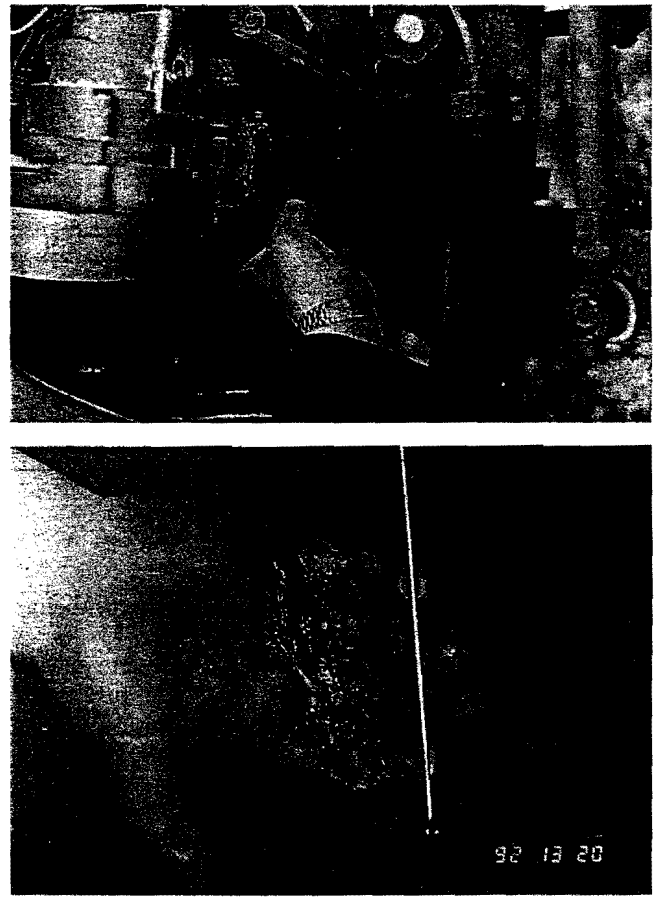


Fig 1 Pathogenesis of typical lesions of rolling belt injuries.

**Table 2—Clinical results of rolling belt injuries**

| *Case* | *Age years* | *Sex* | *Injured finger* | *Type* | *Procedure* | *Result* | *Follow-up months* | *Secondary procedure* |
|---|---|---|---|---|---|---|---|---|
| 1 | 2 | F | Index | 4 | Stump closure | Good | 48 | |
| 2 | 3 | F | Index | 1 | All fingers grafted | Good | | |
| | | | Middle | 1 | | | | |
| | | | Ring | 1 | | | | |
| 3 | 3 | M | Middle | 4 | Stump closure | Poor | 24 | |
| | | | Ring | 4 | Stump closure | | | |
| | | | Little | 4 | Stump closure | | | |
| 4 | 3 | M | Ring | 2A | Flexor tendon repair and skin grafting | Fair | 26 | |
| 5 | 3 | M | Middle | 2A | All fingers | Good | 12 | Corrective osteotomy |
| | | | Ring | 3A | Flexor tendon repair and | | | |
| | | | Little | 3A | skin grafting | | | |
| 6 | 1 | M | Middle | 1 | Skin grafting | Fair | 12 | |
| | | | Ring | 2A | Flexor tendon repair and | | | |
| | | | Little | 3A | skin grafting | | | |
| 7 | 4 | M | Ring | 4 | Stump closure | Good | 12 | |
| | | | Little | 4 | replantation of finger | | | |
| 8 | 3 | M | Middle | 3B | Stump closure | Good | 8 | |
| | | | Ring | 2A | flexor tendon repair | | | |
| 9 | 9 | M | Middle | 2A | Flexor tendon repair + skin grafting | Good | 6 | |
| 10 | 2 | F | Index | 3B | Revascularization and flap | Poor | 48 | |
| | | | Middle | 3B | Revascularization and stump closure | | | |
| | | | Ring | 3B | Revascularization and stump closure | | | |
| | | | Little | 3B | Revascularization and stump closure | | | |
| 11 | 2 | M | Index | 2A | All fingers covered | Fair | | |
| | | | Middle | 2A | with groin flap and | | | |
| | | | Ring | 2A | flexor tendon repair and | | | |
| | | | Little | 2A | flap reconstruction | | | |
| 12 | 1 | M | Middle | 3B | Revascularization and stump closure | Good | 48 | Tenolysis and web reconstruction |
| | | | Ring | 3B | Revascularization and skin grafting | | | |
| | | | Little | 3B | Revascularization and skin grafting | | | |
| 13 | 4 | M | Middle | 3A | All fingers flexor tendon | Good | 6 | |
| | | | Ring | 3A | Repair and skin grafting | | | |
| | | | Little | 3A | | | | |
| 14 | 4 | M | Middle | 3B | Revascularization + stump closure | Good | 6 | Tenolysis |
| | | | Ring | 3B | Revascularization + skin grafting | | | |
| | | | Little | 3B | Revascularization + skin grafting | | | |
| 15 | 1 | M | Index | 4 | Stump closure | Poor | 18 | |
| | | | Middle | 4 | Replantation and stump closure | | | |
| | | | Ring | 4 | Replantation and stump closure | | | |
| | | | Little | 4 | Stump closure | | | |
| 16 | 4 | M | Index | 3B | Flexor tendon repair | Fair | 6 | |
| | | | Middle | 3B | Revascularization | | | |
| | | | Ring | 3A | Skin grafting | | | |
| | | | Little | 3A | Skin grafting | | | |

flaps. Skin grafts were needed for additional hypothenar injuries in 11 cases.

Stump closure was performed in 13 fingers of six patients. Seven of these fingers were the results of unsuccessful replantation or revascularization.

As a result 71% of fingers were viable. Restoration of circulation to the 14 non-viable or amputated fingers was successful in 50%, but only one replantation out of three was successful.

Precise functional assessment in this age-group is difficult, and using a rough functional assessment (Table 3) we found that seven cases were good, seven fair and two poor. The thumb was not involved in any of the cases.

## DISCUSSION

Engine belt injuries, mostly seen in children, cause serious friction burns, defects in tendons and nerves, and devascularization or amputation of the fingers. This particular pattern of injury has been reported as a group.

Nine cases Type 2A demonstrated that intact dorsal skin can supply enough finger circulation in children in the absence of a fracture, as there were no Type 2B

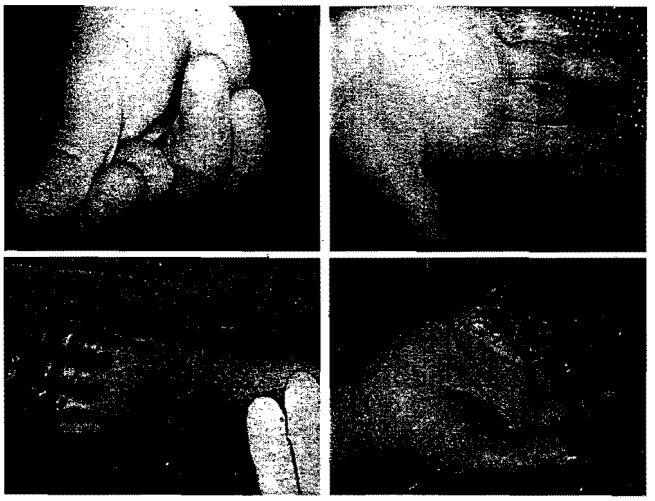

Fig 2 Functional results of a rolling belt injury (Type 3B) in a 4-year-old child, 6 months after operation (Case 14).

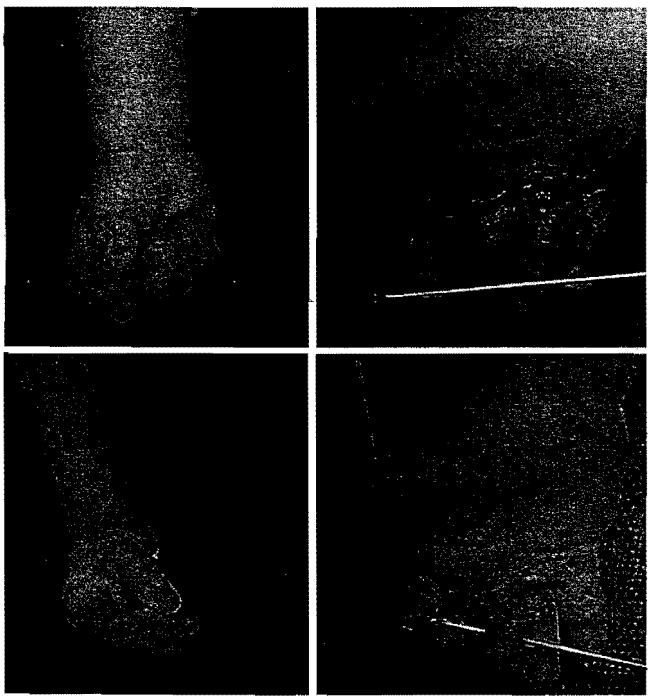

Fig 3 Functional results of rolling belt injuries (Type 3A and 3B) in a 1-year-old child, 6 months after operation (Case 16).

**Table 3—The rough assessment of results used (Gorsche and Wood, 1988)**

| |
|---|
| *Good*—Useful grasp and pinch independent of the opposite extremity |
| *Fair*—Function that assists the other hand |
| *Poor*—No useful function |

injuries. In the presence of a fracture there were eight fingers surviving on dorsal skin only (Type 3A) but 13 fingers not surviving (Type 3B). Therefore, when circulation was present, we concentrated on reconstruction of skin, nerve and tendon lesions, rather than spending time repairing vessels.

The success rate in replantation and revascularization of 50% compares with Urbaniak's series in children under 14 years of age which quotes 62%. The low success rate can be attributed to the small diameter of the vessels, a high rate of avulsion, and the fact that in children the indications for replantation are pushed to the limit (Urbaniak, 1984).

## References

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