# B/S Brace as an Alternative Treatment for Ingrown Toenails

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To the Editor: Ingrown toenail, also known as onychocryptosis or unguis incarnates, occurs when the periungual skin is punctured by its corresponding nail plate, resulting in a cascade of foreign body, inflammatory, infectious, and reparative processes. Most commonly, big toe is involved. Without proper treatment, it would be very painful and negatively affects the patient's walking and greatly hampers the quality of the individual's life. Till now, many different treatments have been proposed. In general, the treatment for ingrown toenails can be divided into conservative approaches (including medical and podiatric methods) and surgical approaches. The choice of treatment is usually based on the Heifetz classification stage of the ingrown toenails. Mostly ingrown toenails with Heifetz Stage II and III need surgical approaches or podiatric methods.[1] So far, surgical management has two approaches: the techniques focused on the periungual skin and those on the nail plate.[2] Nail extraction is still highly used in clinical practice in China. But to some extent, almost all treatments including VHO-Osthold brace or Oniko nail brace were limited in special patients such as aged or diabetic patients. The surgical approaches including nail extraction and chemical methods would damage integrity of nail normal tissue structure leading cosmetic side effects. Besides, there is the possibility of secondary infections. Hence, a noninvasive effective treatment is urgently required, especially for aged and diabetic patients. B/S Brace is made of a special synthetic fiberglass material and works as a spring while both ends pulling the nail plate from the corresponding nail groove according to a classic physical principle: less flexure less strength while more flexure more strength. The reset force of the braces individually corrects the dislocation of ingrown toenails. This study compared the efficacy of B/S Brace and nail extraction on ingrown toenails.

A total of 60 patients (36 males and 24 females) with Stage II or III, one-sided ingrown toenails at the great toe according to the Heifetz classification, who were admitted in the Huadong Hospital Affiliated to Fudan University due to pain, granulation, and difficulty walking, were retrospectively analyzed. The patients with clinical fungal infection, neurologic or vascular disease, or recurrence and those who did not complete the treatment were excluded from the study. These patients would get information of two therapies for ingrown toenails and were divided into two groups according to treatment determined by patient preference: 28 patients treated with B/S Brace and 32 patients with nail extraction. The mean age of all patients was 49.9 years (range: 21–71 years).

For B/S Brace group, the material and devices used in the treatment consisted of the foot care unit SIRIUS NT MICRO, Milling tool set, and the B/S Brace Classic from Eduard Gerlach GmbH (Germany). The surface of toenail was prepared by targeted grinding and carefully degreasing without hurting the adjacent skin; in addition, the braces were well prepared by grinding the ends [Figure 1a]. This preconditioning could make the toenails thin enough to be easily corrected mechanically. Targeted grinding, especially at the ends of the brace, was the unique and simple way to adjust the pulling forces of the B/S Brace to achieve the best, pain-free correction of the nail. After the pretreatment, the special clue on the B/S Brace was applied. The center of braces was fixed at the first, and then, both ends were fixed. After that, individual adjustment of tension was made. The 2-mm space was left between the braces and the nail fold [Figure 1a]. The braces would be changed once a month until all symptoms, in particular, pain and edema vanished and the curvature of the nail opened. The pain score once a month was evaluated until the end of the clinical treatment.

For nail extraction group, digital nerve block anesthesia was administered using 2% lidocaine. Using a pair of scissors, the nail was divided from the front edge to the proximal base, and the ingrown portion of the nail was lifted out of its bed mainly by blunt dissection. A curved forceps was inserted subungually to clamp the toenail and roll over on exposed nail bed and gently the whole nail plate was removed. In patients with granulation tissue, the granulation tissue was curetted. After the procedure, the nail bed was covered with petrolatum gauze and the wound was covered with povidone iodine gauze. In the end, a pressure dressing was applied. Patients were instructed to keep the digit dry for the first 7 days after the operation and were advised to change the dressing every 3 days in the first 2 weeks. Patients' quality of life, pain score, and toenail width were evaluated before

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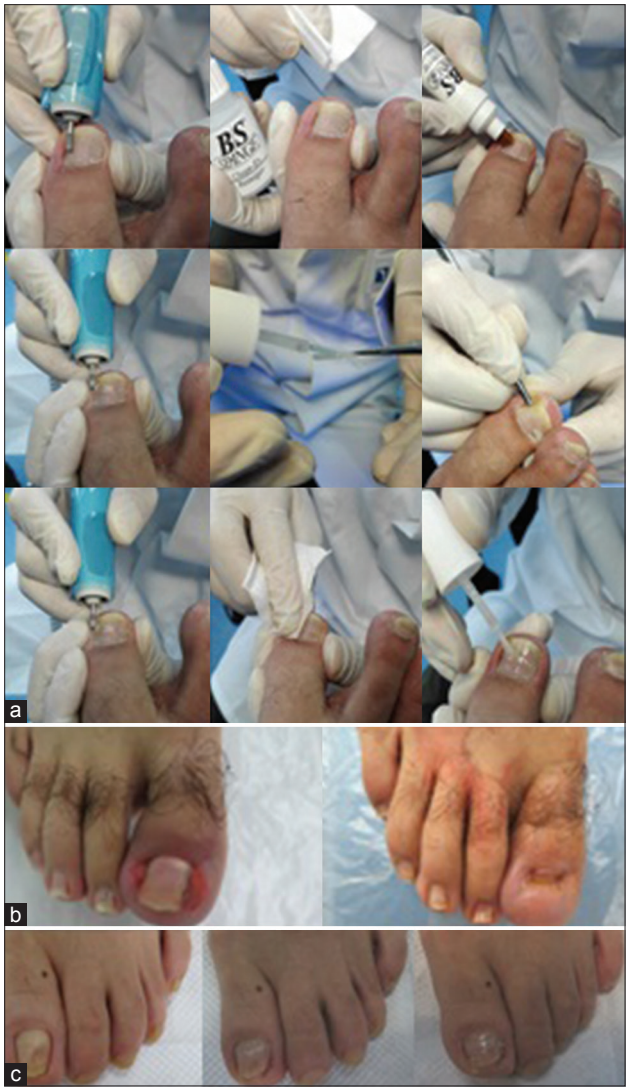


**Figure 1:** (a) Procedure for nail brace application to treat ingrown toenails. (b) Images of patients before treatment and 7 days after treatment in the nail extraction group. (c) Images of patients before treatment and 7 and 14 days after treatment in the B/S Brace group.

treatment and every 30 days after treatment until the end of the clinical treatment.

Patient satisfaction was compared between two groups in terms of the pain score during the procedure, the time of pain-free walking while wearing normal shoes, the incidence of recurrence, and the complications. The numeric rating scale (NRS) was used to assess the pain before and after the treatment (before and after first brace application in the B/S Brace group). We evaluated the curative effect and recurrence rate by telephone. The follow-up duration was 12 months after the end of treatment.

Statistical analyses were performed using SPSS software package for Windows, version 16.0 (SPSS Inc., Chicago, IL, USA). The data were presented as mean ± standard deviation (SD). Student's *t*-test and Chi-square test were used to compare two groups. A $P < 0.05$ was considered statistically significant.

Patients in nail extraction group were elder (mean age: 51.2 ± 14.1 years) than that of the B/S Brace group (mean age: 48.5 ± 11.9 years) but without statistical significance ($t = 0.7941$, $P = 0.430$). In addition, there was no statistically significant in gender ($\chi^2 = 0.0048$, $P = 0.944$), the side of the ingrown toenails ($\chi^2 = 0.0012$, $P = 0.972$), the infection condition ($\chi^2 = 2.7632$, $P = 0.096$), and the Heifetz stage ($\chi^2 = 0.9182$, $P = 0.338$) between two groups.

The NRS scores at rest (PAR, affected foot elevated) and under loading (PCL, walking while wearing shoes) before treatment were different between B/S Brace and nail extraction groups but without statistical significance (PAR: 2.143 ± 0.210 vs. 2.281 ± 0.202, $t = 0.4738$, $P = 0.637$; PCL: 6.250 ± 0.320 vs. 6.063 ± 0.356, $t = 0.3872$, $P = 0.700$; respectively). However, the mean NRS score after treatment in the B/S Brace group was lower than that of the nail extraction (0.393 ± 0.093 vs. 4.938 ± 0.250, $t = 16.1500$, $P < 0.001$).

Patients in the B/S Brace group could wear regular shoes without suffering severe pain after the first treatment significantly earlier than patients in the nail extraction group [Figure 1b and 1c]. All 28 patients in B/S Brace group walked pain free on the day of the first treatment or the following day, whereas most of the patients in the nail extraction group took off from work for at least 7 days. The days to wear regular shoes in the B/S Brace and nail extraction groups were 0. 68 ± 0.09 and 13.44 ± 0.65 days ($t = 18.1500$, $P < 0.001$).

The mean number of visit to the therapist in B/S Brace group was 3.7 ± 0.2, which was significantly less than nail extraction group (6.2 ± 0.2, $t = 10.2800$, $P < 0.001$). By the end of follow-up, 14 patients (43.8%) in the nail extraction group had developed a recurrence and only four patients (14.3%) in B/S Brace group ($\chi^2 = 6.1735$, $P = 0.013$). Among these recurrent patients, four patients in each group required further treatment. One patient in the B/S Brace group was still receiving treatment at the end of the follow-up. Patient satisfaction in the B/S Brace group was higher than the nail extraction group (96.4% vs. 62.5%, $\chi^2 = 11.4612$, $P < 0.001$). Two patients in the nail extraction group developed secondary infection in the 1st week and the 3rd week, respectively, and no patient developed secondary infection in the B/S Brace group.

Ingrown toenails or onychocryptosis is a common problem that can affect walking and preclude daily activities. It is one of the most frequent nail disorders in young people particularly in the 14–25 age groups. There are several reasons why an ingrown toenail develops, including improper nail trimming or tearing nails off, ill-fitting footwear, trauma, anatomical factors such as thickening of the nail plate, wide base of the distal phalangeal bone with large medial and smaller lateral osteophytes, pressure caused by hallux valgus or toe deformities, lower extremity edema secondary to some systemic illness (diabetes, obesity, and thyroid, cardiac, and renal disorders), and some drugs.[3]

There are many methods in the treatment of ingrown nail clinically. A systematic review suggested that surgical interventions were more effective than nonsurgical interventions in preventing the recurrence of ingrown toenail. Classic nail extraction still is a common choice in China so was chosen as control group in this study. Several studies suggest that phenol cauterization alone or combined with partial nail extraction was a better choice than other treatments getting higher recovery rate and lower recurrence rate and with rarely infection after the operation.[4] However, in special groups such as pregnant women, children, and patients with severe systemic diseases such as aplastic anemia, its application is still limited. Physicians are hoping to find a noninvasive and effective method in the treatment of ingrown nail, especially for the special groups. Some new treatments were designed. Nail braces were one of them, including plastic braces, steel wire, and copper-aluminum-manganese-based shape-memory alloys. Plastic braces are glued on the nail and due to their memory will gently

uncurve the nail. B/S Brace is one of the latest plastic braces. Recently, Guler *et al*.[5] concluded that the nail brace was an appropriate alternative treatment for ingrown toenails with high patient satisfaction, fast recovery times, and a low recurrence rate.

As a result, the pulling forces of the B/S Brace can be adjusted in a unique yet simple way by targeted grinding, especially at the end of the brace to achieve the best, pain-free correction of the nail without any bleeding and trauma and patients' pain is relieved immediately or been back to work at once. In this study, some of the patients presented with blood system diseases. However, none of them developed side effects in the B/S Brace group. It may suggest that B/S Brace can be an option for ingrown toenail patients with diseases of the blood system. It is worth mentioning that none of the patients got secondary infection in the B/S Brace group. Although recurrences may be seen in some patients in B/S Brace group, patients are usually eager to use a repeated course of B/S Brace rather than having an operation.


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## Conflicts of interest

There are no conflicts of interest.

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